THE LEHIGH FARM BOOK of STRUCTOGRAPHS

LEHIGH CEMENT

Wm. E. Zerbe Lbr. Co.

Lumber - Cement

Pine Grove, Pa.

(1927)

THE LEHIGH FARM BOOK OF STRUCTOGRAPHS

MAKE PERMANENT IMPROVEMENTS TO YOUR FARM

TODAY the progressive farmer recognizes the economy and lasting satisfaction of making permanent improvements to his farm. In concrete he has the most valuable building material to use in securing such construction.

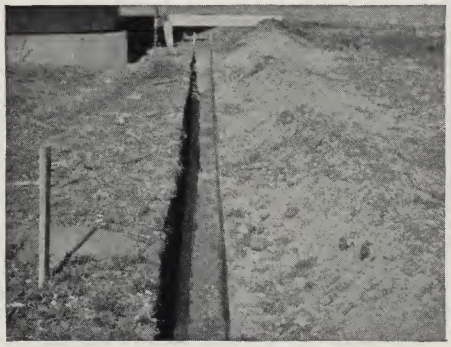
It is strong—will withstand years of service without requiring replacing, repairs or any upkeep costs whatever. It insures sanitary conditions wherever used, and has the recommendation of the health authorities everywhere.

Concrete construction modernizes the farm, saves a great deal of work, and provides many conveniences which the farm of twenty years ago could not boast. Concrete construction is not expensive but is almost as reasonable in first cost as other construction of less value. With all these qualities it is not surprising that today millions of barrels of cement are used on the farm.

When you decide to build of concrete, you will find this book of structographs, picturing actual construction work on the farm, decidedly helpful. You can follow the pictures and data with every assurance of getting satisfactory results.

When buying your cement be assured of the best results by consulting the Lehigh dealer—the man who displays the Blue-and-White "Lehigh Cement" Sign. He is a good man to know and can help you; and always use Lehigh Cement—Lehigh means Dependability.

FOUNDATIONS AND WALLS



Trench for foundation wall. Where the soil is firm and has been carefully dug, forms are not necessary

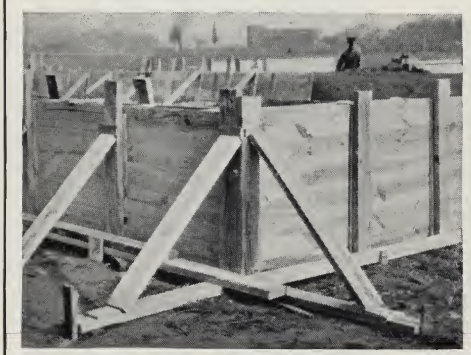
Placing the concrete. A mix of 1 part cement, 2½ parts sand and 4 parts gravel or stone is recommended for foundations

Tamp concrete into place to get a compact wall, with no air pockets that require patching when forms are removed

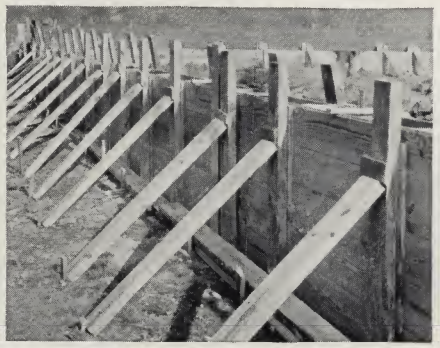
Foundation for the wall poured to the ground level. The section of the wall above ground can now be constructed

THIS series of photographs illustrates the method of constructing the concrete foundation wall of a dairy barn. The footing and base of the wall are wider than the top, which tapers off to receive the sill. The dimensions of foundations and walls will, of course, depend upon the type and weight of the building.

Forms for the wall are built over the foundation. Bolts to fasten the sill are placed in position in the forms



Method of bracing corner. Strong, well-braced forms are necessary to hold wet concrete in place until it hardens



Method of bracing side wall. Use but few nails. Practically all this form lumber can later be used in the building

Tie-wires and spreaders. Wires are twisted until forms are tight. Spreaders are removed before concrete covers them

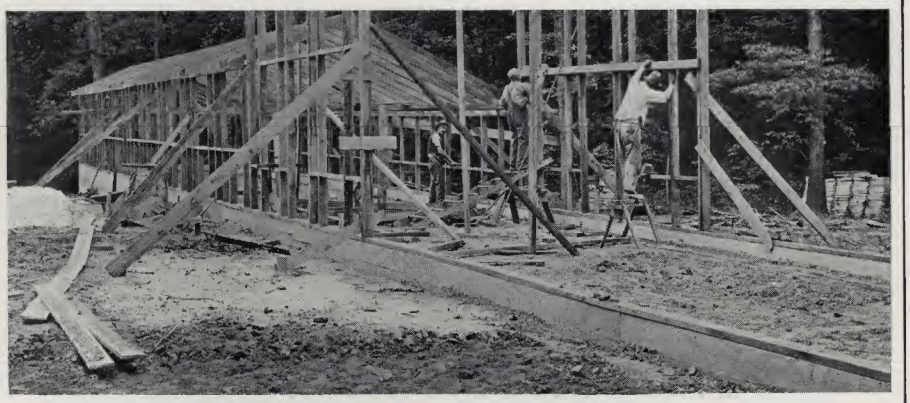
A few boards used to direct the concrete while pouring will prevent the loss of materials over side of forms

Wall forms completely filled. Concrete should be spaded while it is being poured, to secure a surface free from air holes

Forms removed. The wall is now ready for the superstructure. Note the bolts for anchoring sill to the foundation

POULTRY HOUSE FLOORS

The foundation wall for a poultry house, with sills and framing in position. Foundation should extend below the frost line

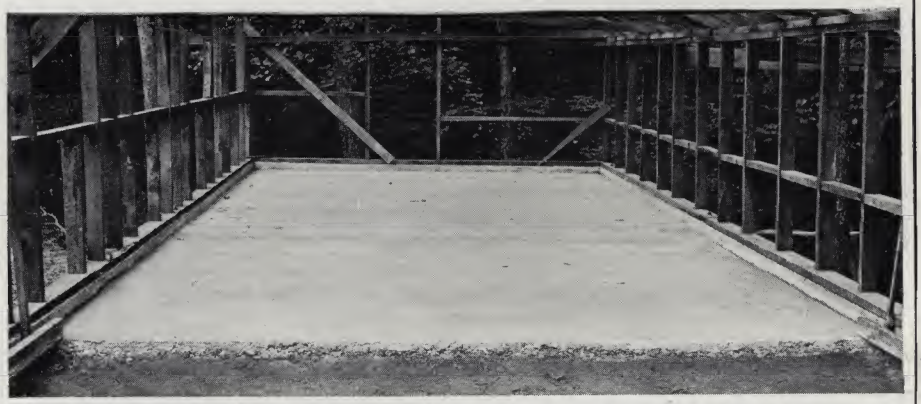


Ready for the concrete floor. A mixture of 1:2:3½ concrete (1 part cement, 2 parts sand, and 3½ parts gravel or stone) is recommended for both foundation wall and floor. Gravel or stone up to one inch in size can be used in mixing the concrete

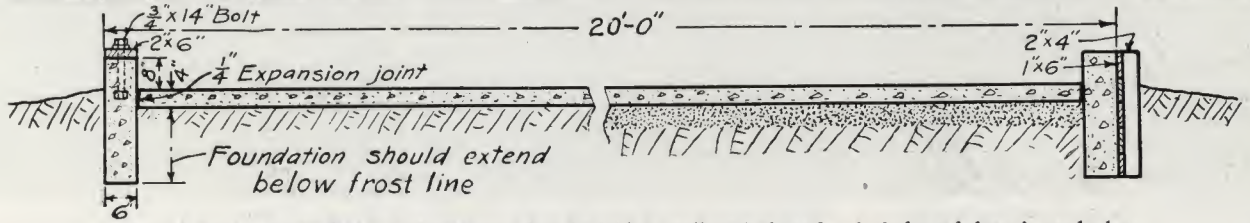
Pouring a 4-inch layer of concrete for the floor. Tamp thoroughly to make a dense, solid mass. The two men at the right are placing a 2 x 4 at the correct floor level

Leveling the concrete. Note how the 2 x 4's at the sides furnish a guide for the strike-off board. Expansion joints of several layers of roofing paper should be placed between wall and floor

Poultry house floors should be given a smooth surface with a steel trowel. Rough finished floors wear away toe-nails of birds



The floor should have plenty of time to dry thoroughly before being used, as fresh concrete contains considerable moisture. If the house must be used at once, it is best to install the floor first and build the superstructure afterward

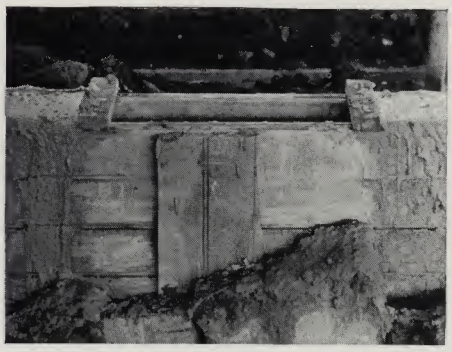


Plan of poultry house floor. Concrete can often be laid on well-packed earth. A cinder sub-base is used when drainage is necessary. Both methods are illustrated here

DAIRY BARN FLOORS

Interior of a dairy barn, ready for the placing of a concrete floor. Note the concrete foundation wall. Concrete foundations support the posts. A 1:2½:4 concrete mixture (1 part cement, 2½ parts sand, and 4 parts gravel or stone) is recommended for barn floors

The curb between the manger and the stall is poured first, to hold the steel stall posts in place. Remove sharp corners with an edger



A standard form to produce cut-out in the curb can be supplied by the manufacturer of the dairy barn equipment

THIS series of photographs illustrates the steps to follow in laying a dairy barn floor. In this installation the metal stall equipment is set in place before the concrete is poured. Other types of equipment, using anchors to hold the stall posts, may be used with a slight variation of the method shown.

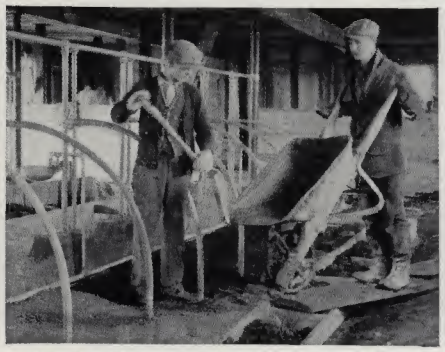
Curb with forms removed. A lower curb, with no cut-out, can be used if desired. Low level curb should be 6 inches high

Water pipes for individual drinking cups and drains in gutter and mangers must be installed before placing the concrete

The earth foundation should be wet down and thoroughly tamped to insure solid packing before pouring concrete

The bottom of the concrete gutter should be wide enough to allow stall and alley floors to overlap several inches

Floor and alley forms over the gutter foundation. A little soil placed in forms holds them in place while pouring the concrete



Placing the concrete for the stall floor. This floor should be from 2 to 4 inches above the level of the litter alley

Leveling the concrete in the litter alley. For good drainage, the incline from foundation wall to gutter should be one inch

DAIRY BARN FLOORS—Continued

A non-slip surface is obtained with a wood float. The incline of the stall floor from the curb to the gutter is one inch

Mounding the concrete in a cone around the stall partitions prevents rusting of metal where it enters the concrete

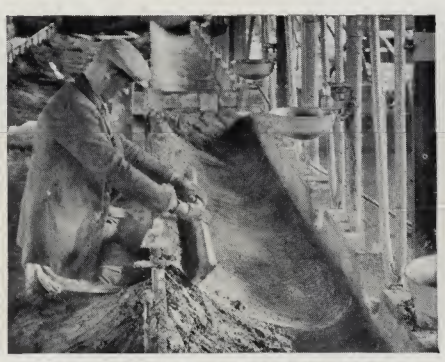
Finishing with an edger to produce a rounded corner, preventing the concrete from chipping. Avoid sharp corners

The forms in the gutter have been removed and the litter alley, gutter and stall floor are now complete

Forms for feed manger. Steel templets, placed 3 to 4 feet apart, to form the curve, are shown in next illustration

Form is partially filled with earth, tamped thoroughly to provide a solid foundation. Leave room for a 4-inch layer of concrete

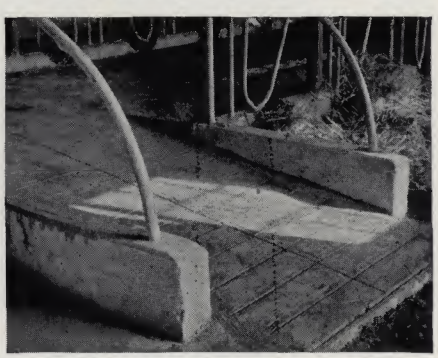
Two courses are needed. The first (1:2½:4 mix) should be very stiff, in order that it will hold its position until it sets



The second course, made of one part cement and 3 parts sand, should be placed immediately to form a good bond

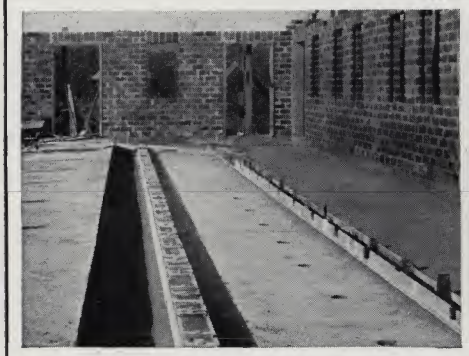
A steel trowel produces a smooth, easily cleaned surface. Do not use trowel more than necessary to obtain smoothness

The concrete for the feed alley can now be placed between the mangers, after filling in with well-tamped earth to the required level. This installation shows a feed alley raised to the top of the mangers. Another type is illustrated on page 7

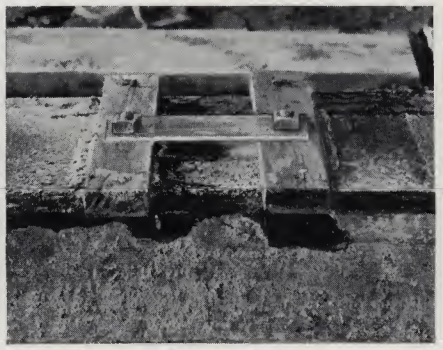


The incline from feed alley to litter alley is finished with a rough surface and grooved to furnish a non-slip surface

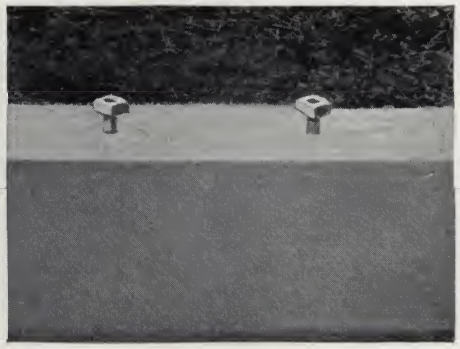
DAIRY BARN FLOORS Installing Equipment with Anchors



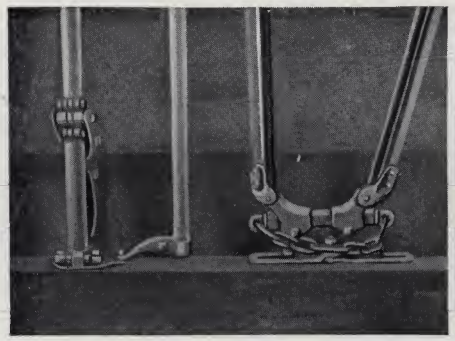
Dairy barn equipment installed with anchors. Concrete is poured before metal stalls are erected



Method of holding anchors for stall posts and stanchions while concrete is being placed in curb



Forms removed from curb, showing bolts in the concrete ready to receive the dairy barn equipment

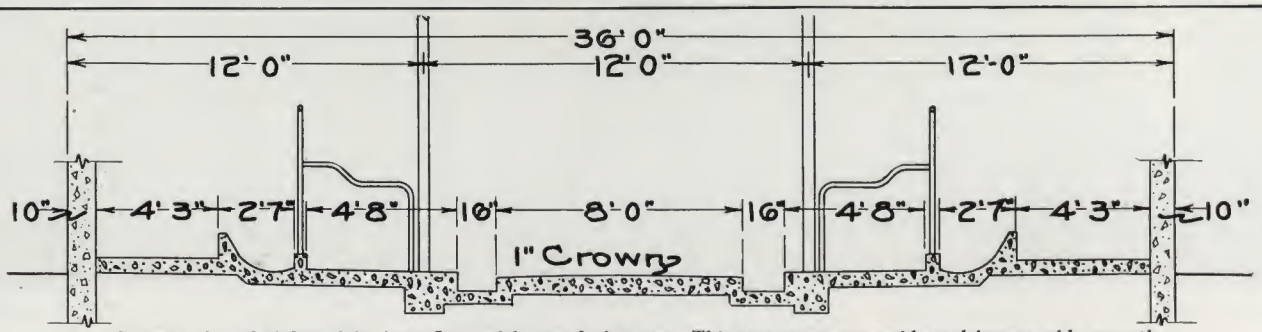


Stall posts and stanchions bolted to curb. Stanchion has an adjustment of several inches backward and forward

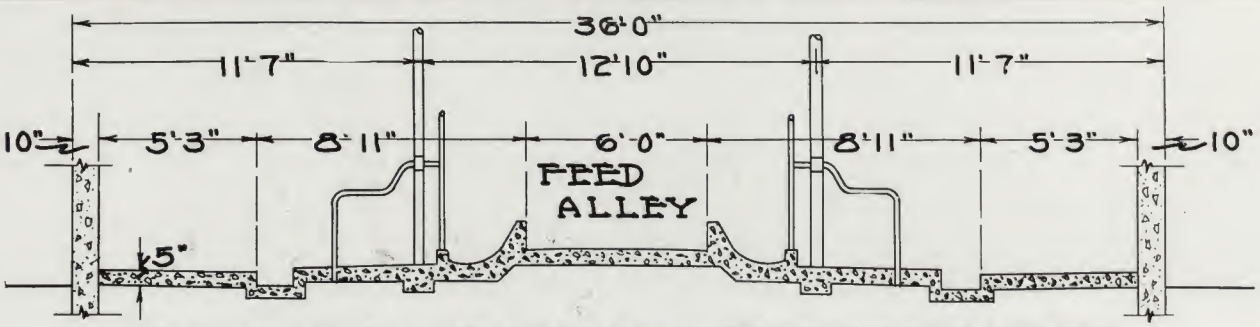
Holes to receive the stall partitions may be made with stakes, milk bottles, or metal tubes. Remove before concrete hardens

Stall partitions are placed in position and the hole is filled with a mortar of one part cement and three parts sand

PLANS OF DAIRY BARN FLOORS



Cross-section of 36-foot dairy barn floor, with cows facing out. This arrangement provides a driveway wide enough for a manure spreader. The interior may be kept cleaner, as the walls are not spattered with manure



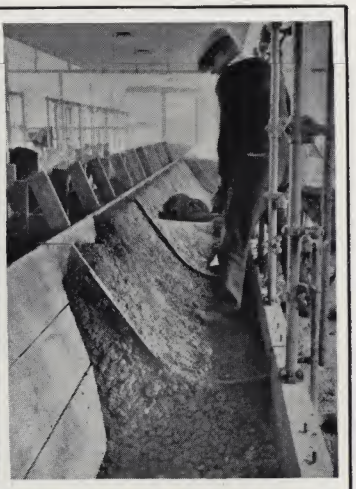
Cross-section of 36-foot dairy barn floor with cows facing in. This arrangement provides a central feed alley. Direct sunlight falls on the gutter and cow stalls and there is no strong light in the eyes of the cows

PLANS THROUGH COURTESY OF IOWA STATE COLLEGE

DAIRY BARN FLOORS—High Manger

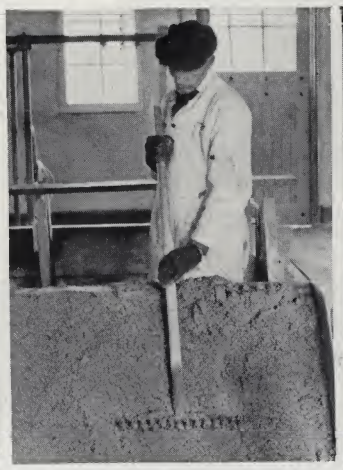
Forms for construction of a high manger for a dairy barn. This type of manger prevents the cows from pushing the hay out of the manger into the feed alley

The forms must be well braced to support the weight of the wet concrete



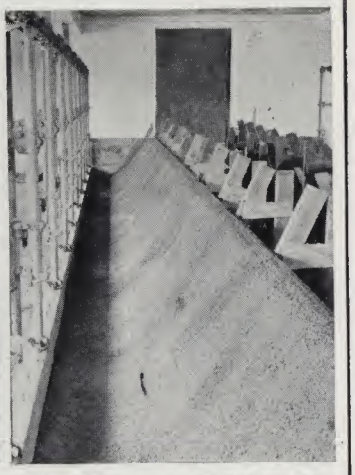
Filling forms with a stiff mixture of one part cement, two of sand and four of gravel or stone

Concrete is firmly tamped. The stiff mixture gives an excellent bond to top coats



A thin layer of 1:3 concrete (one part cement and three parts sand) is now placed

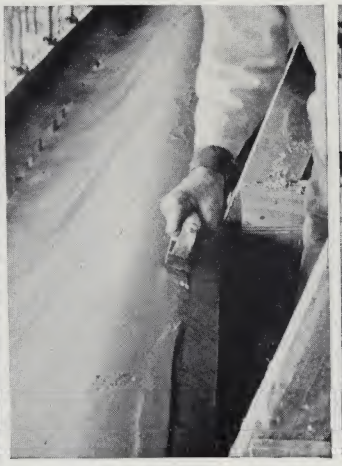
Striking off the concrete, using the metal templets as guides for the straightedge



Second course completed. This brings the concrete to the level of the templets

The final finishing coat is a very thin layer of one part cement and three parts fine sand

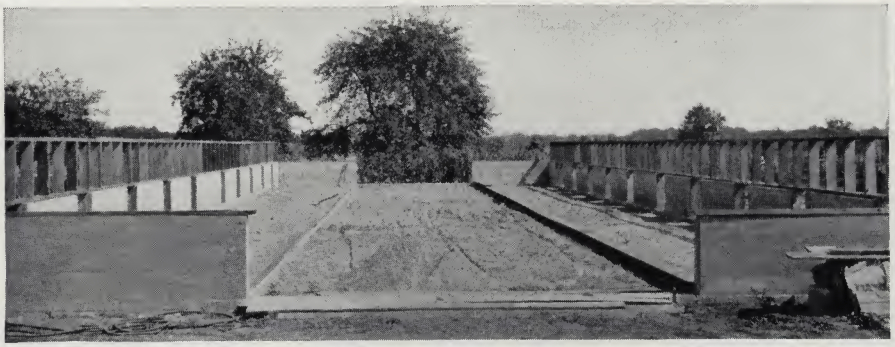
A steel trowel is used to give a smooth finish which is sanitary because it is easily cleaned



A rounded edge improves the appearance and prevents corners from chipping

Manger completed. It should be kept wet for several days to cure the concrete properly

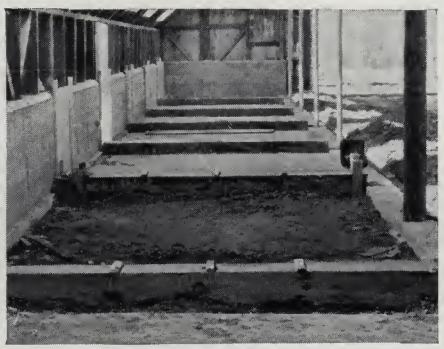
HOG HOUSES



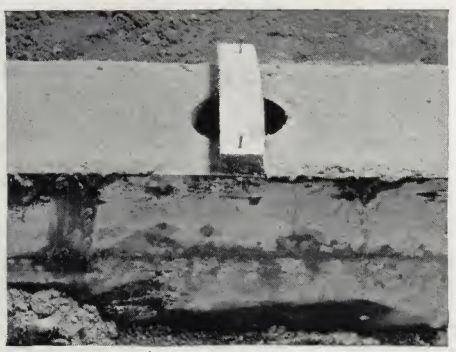
Hog house under construction. Foundations and walls have been poured, using a 1:2½:4 concrete mixture (1 part cement, 2½ parts sand, and 4 parts stone or gravel). Floors for feed alley and hog pens can be made of a 1:2½:4 mixture also

Detail of corner of concrete wall. Note the doors in the wall for entrance between pens and outside runs

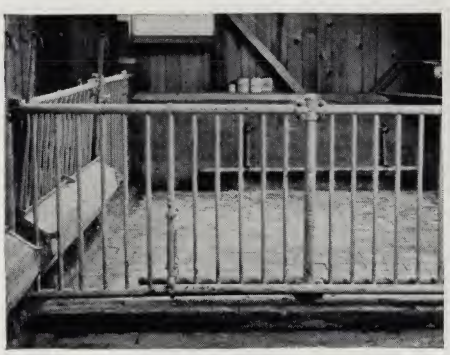
View from end of house, showing entrance to center feed alley. Note drainage outlets in position at floor level



Forms for concrete curbing to hold metal partitions between the pens. In rear, floors have been poured



Metal tubes are used to form holes in the concrete curbing in which to place partition posts



Metal partitions erected. Posts are placed in holes formed by anchors, and a 1:3 concrete mixture poured around them

A feed room is conveniently placed near the center of the house. Forms are in position ready for pouring the walls

Walls of feed room completed. Space is provided for a small stove, mixing barrels, and a small supply of feed

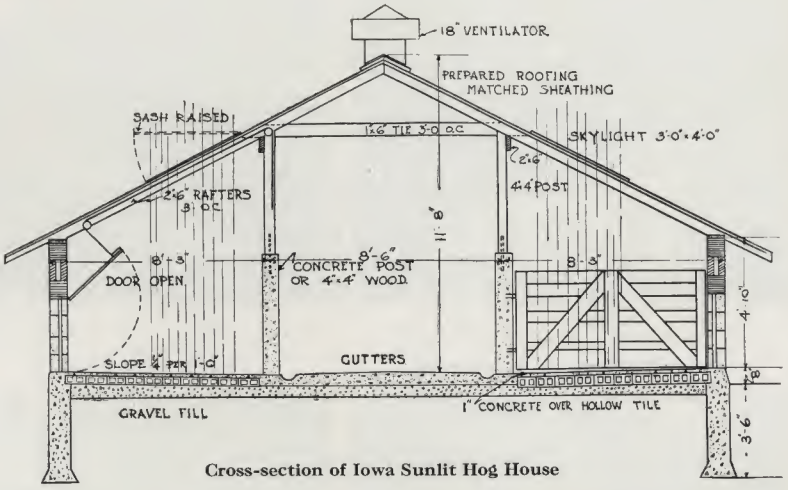
Row of individual pens, each with its clean, dustless concrete floor. Note the gutter along the front of the pens

Interior view of completed hog house. It is warm and dry, and there is an abundance of direct sunlight. The concrete construction offers superior sanitary advantages. Smooth walls and floors, with no inaccessible crevices, encourage healthfulness

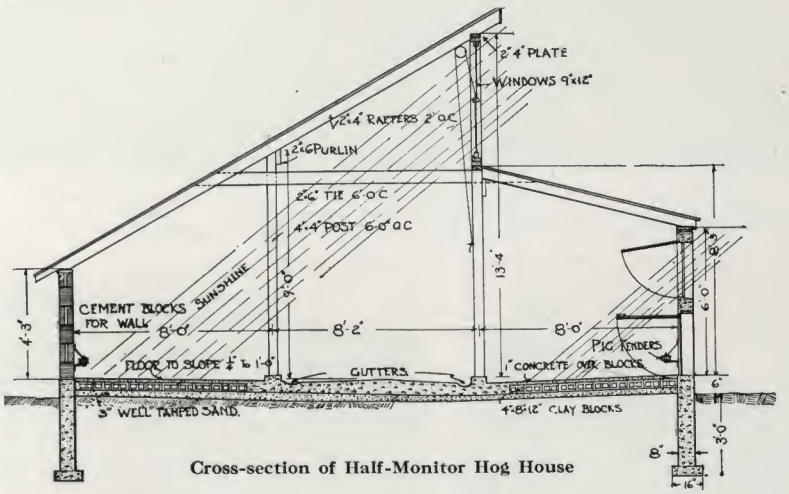
HOG HOUSES—Continued

Iowa Sunlit Hog House

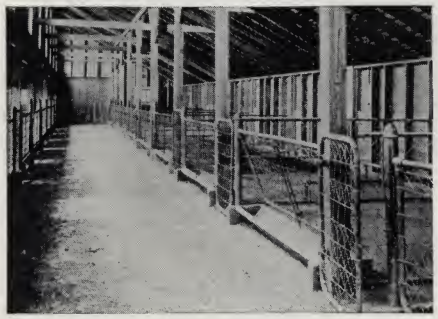
The long rows of skylight sash in the roof assure an abundance of warm, direct sunlight which is so essential in the housing of the brood sow that farrows in early March. Concrete posts are cast in place to hold the removable partitions and gates



Cross-section of Iowa Sunlit Hog House



Cross-section of Half-Monitor Hog House

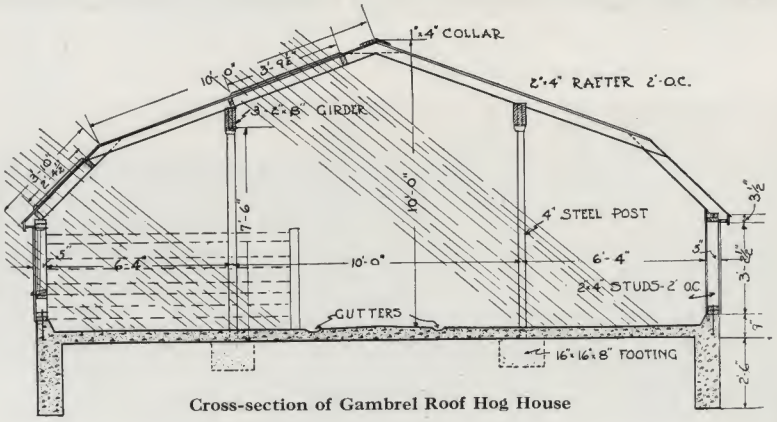


Half-Monitor Hog House

A great amount of sunlight falls upon the pen floors and walls of this house. Pen floors are of concrete, underlaid with four-inch building tile on a base of well-tamped sand

Gambrel Roof Hog House

The building in the illustration differs somewhat from the cross-section plan, as it shows four rows of skylights in the roof instead of two rows on the south side only. The concrete for the floor is to be made of a 1:2½:4 mixture (1 part cement, 2½ parts sand, and 4 parts gravel)



Cross-section of Gambrel Roof Hog House

PLANS THROUGH COURTESY OF IOWA STATE COLLEGE

STORAGE CELLARS

Hollow-wall molds are needed to cast the type "D" wall (see page 12 for detailed drawing) for a concrete storage cellar

Footing and first course of wall completed. Note the reinforcing rods placed in the concrete for the pilaster

Wall partly completed. The dark layer of concrete at top of wall is a fresh course made with the double wall molds

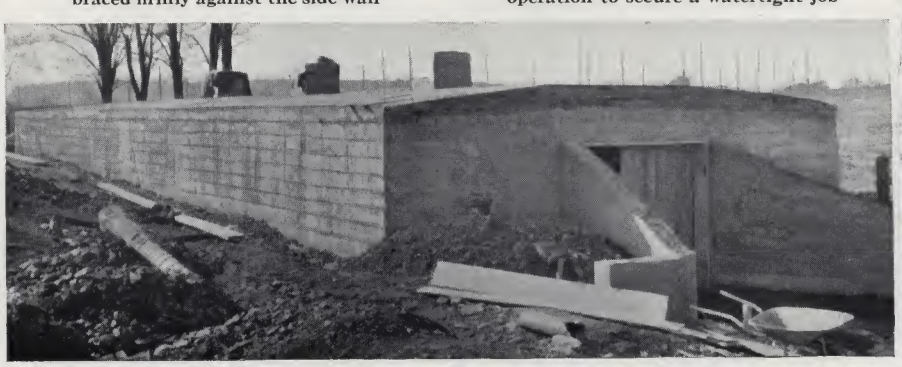
View along top of wall. Note the dead air space between outer and inner walls except at pilasters

Placing the reinforcing for the roof. The roof should be built under the supervision of a contractor experienced in reinforced concrete slab construction. The reinforcing rods can be purchased ready to place in position. The manufacturer will furnish a plan

Forms to hold the concrete for the roof slab are being built. They should be braced firmly against the side wall

Pouring concrete for the roof. The entire roof should be placed in one continuous operation to secure a watertight job

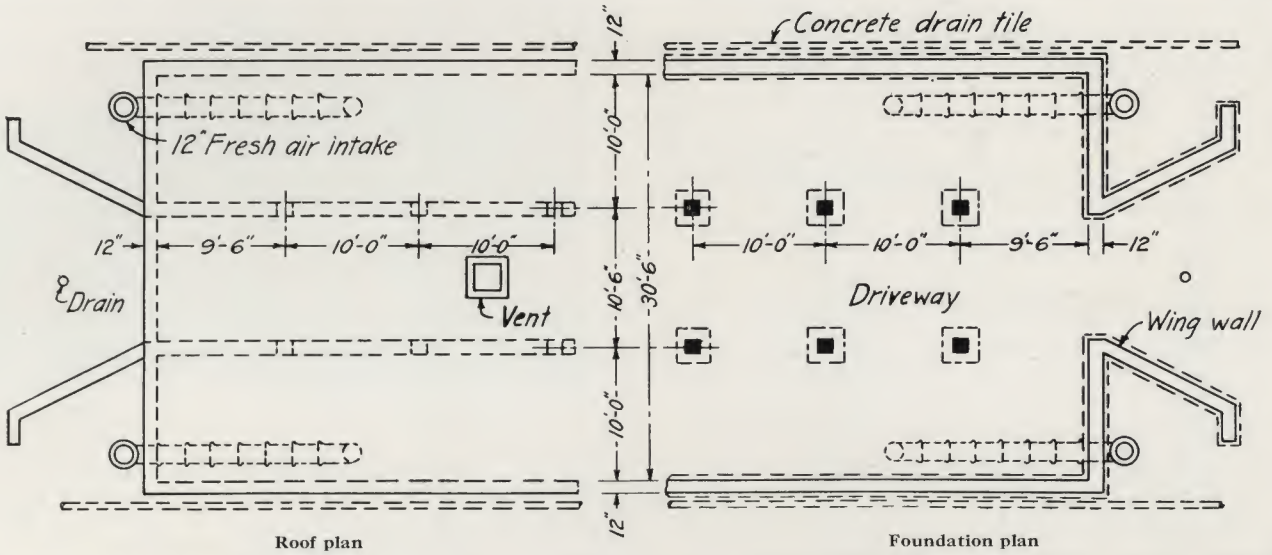
Roof completed. The three forms in the center of the roof are for the construction of the concrete ventilators



Storage cellar practically completed, ready to be covered with earth. For storage purposes, wall types A, B and C, illustrated on page 12, will serve as satisfactorily as the hollow wall (type "D") shown here

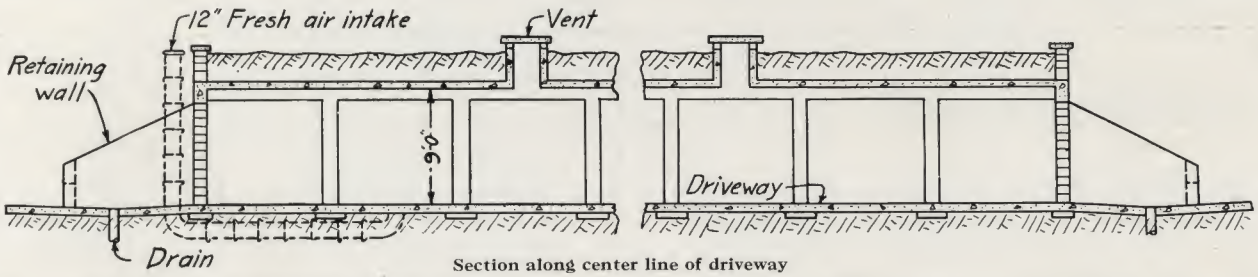
Wing walls solid concrete, 10″ thick. Carry footings below frost line. Reinforcing rods should be used where wall joins cellar

STORAGE CELLARS—Continued

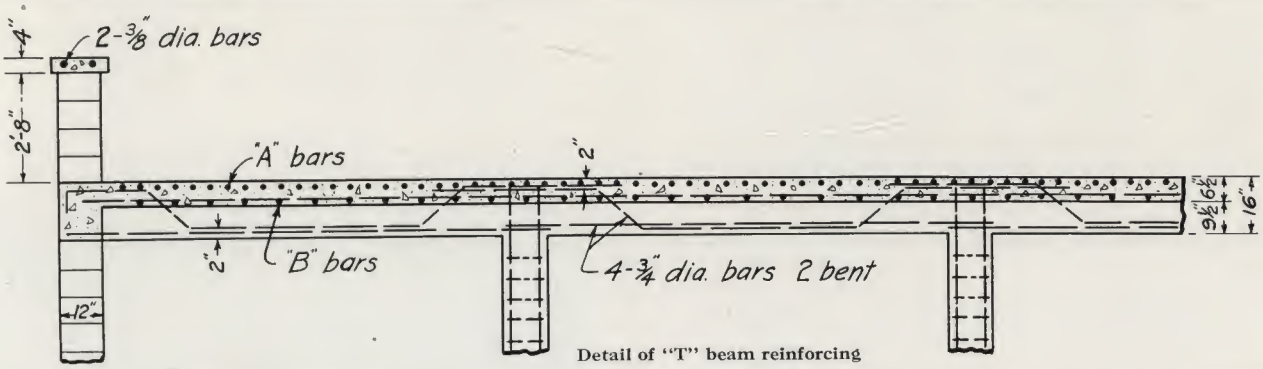


Roof plan

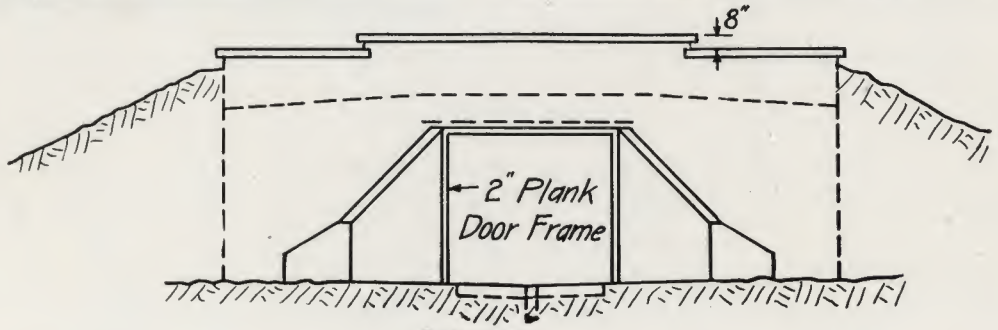
Foundation plan



Section along center line of driveway

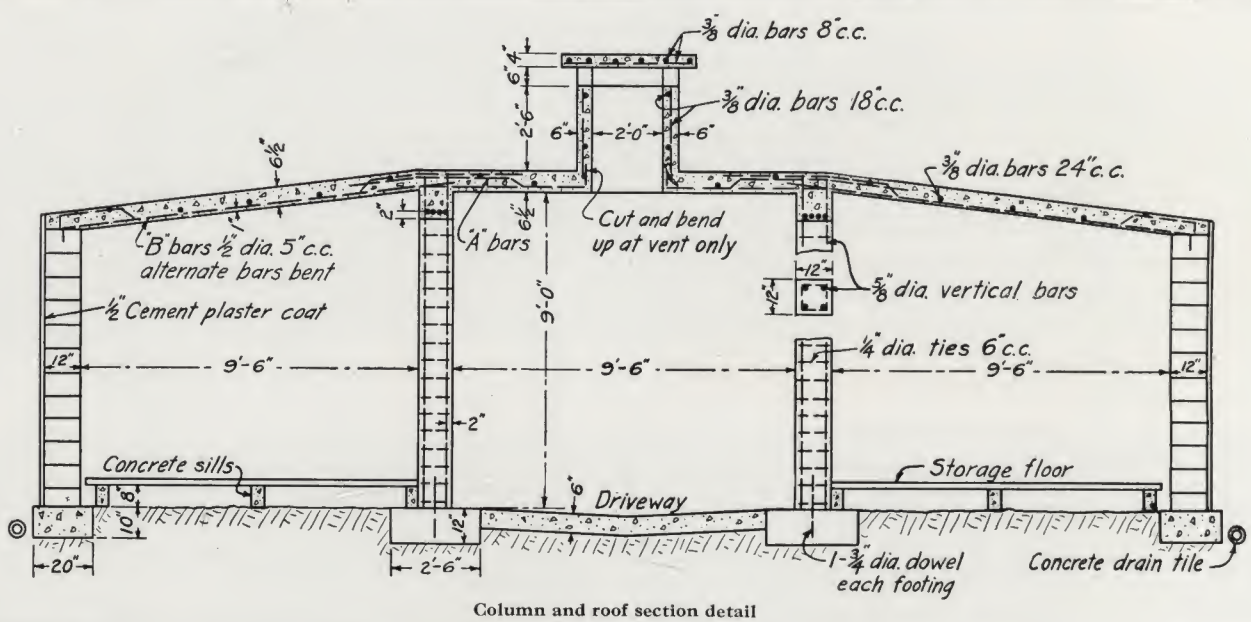


Detail of "T" beam reinforcing

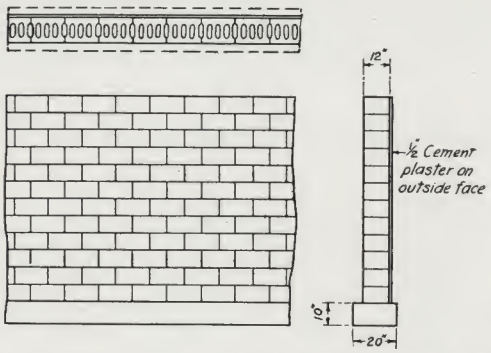


End elevation

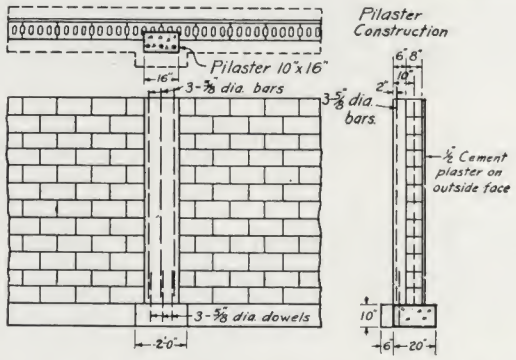
STORAGE CELLARS—Continued



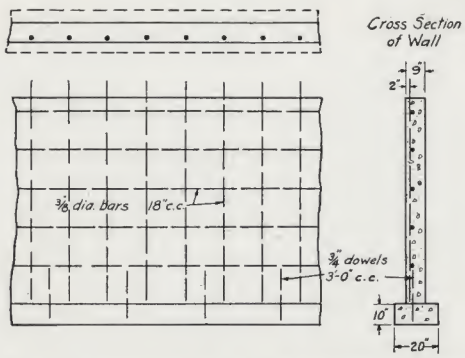
Column and roof section detail



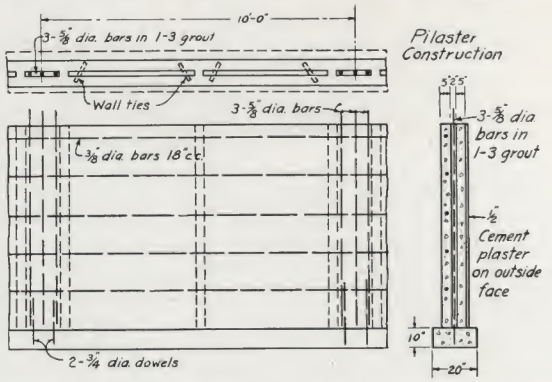
Type "A" wall construction. Wall is 12 inches thick, and is built of 8" x 12" x 16" concrete block, without pilasters. Blocks are laid in a 1:3 Portland cement mortar tempered with not over 10% of hydrated lime



Type "B" wall construction. Wall is 8 inches thick, and is built of 8" x 8" x 16" concrete block, with pilasters projecting on the inside of the storage cellar, and spaced at approximately ten foot centers



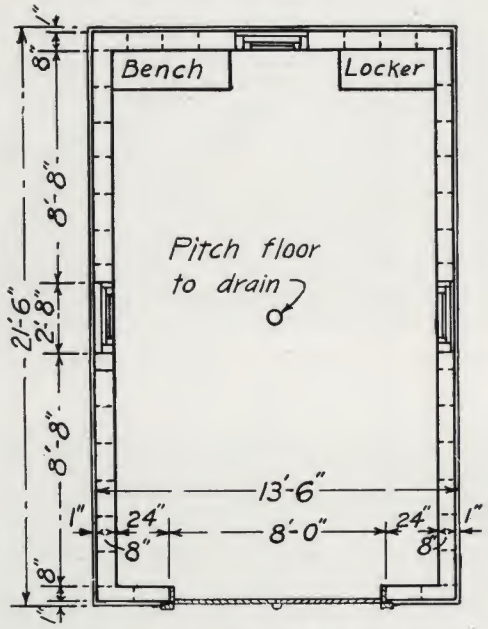
Type "C" wall construction. Wall is 9 inches thick, and is made of a 1:2:4 mixture of concrete, placed in forms on the job. If wall is built in sections, construction joints are necessary



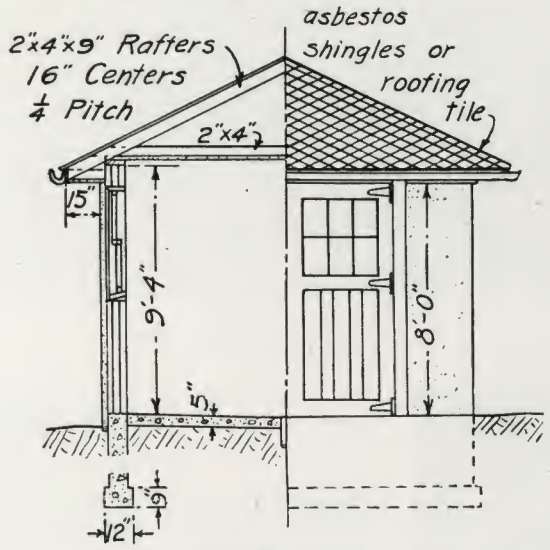
Type "D" wall construction. Wall is 12 inches thick, and consists of two 5-inch thicknesses of concrete separated by a 2-inch air space except at pilasters. Hollow wall molds are used to cast this wall

CONCRETE BLOCK GARAGE

Concrete block garage with a cement stucco exterior



Plan of concrete block garage



Section and elevation

Concrete garage floor

Materials for Garage Superstructure, Foundations, and Floor

Superstructure

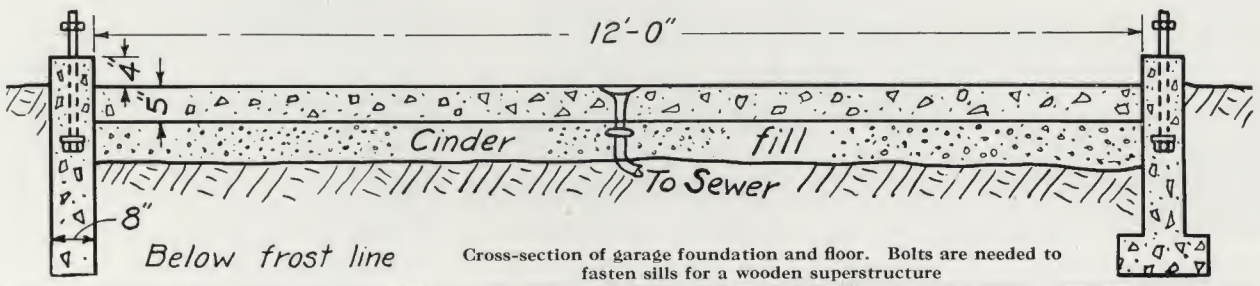
8 x 8 x 16 concrete block	516
8 x 8 x 8 concrete block	42
Sand, ¼ inch and under	2⅔ cu. yds.
Lehigh Cement	24 sacks
Millwork, roofing material, etc., as selected.	

Foundations, 3 feet deep, without footings
Mixture, 1:2½:4
Concrete, 133⅓ cu. ft.

Lehigh Cement	27 sacks
Sand, ¼ inch and under	2½ cu. yds.
Stone, ¼ inch to 1½ inches	4 cu. yds.

Floor, 20 feet x 12 feet x 5 inches
Mixture, 1:2:3½
Concrete, 100 cu. ft.

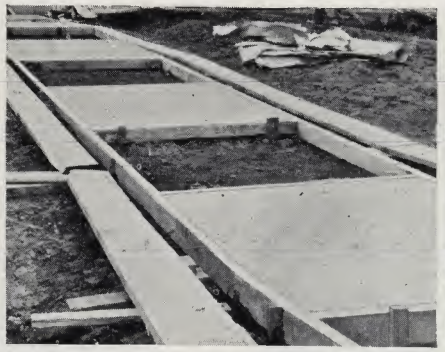
Lehigh Cement	24 sacks
Sand, ¼ inch and under	1¾ cu. yds.
Stone, ¼ inch to 1 inch	3 cu. yds.



Cross-section of garage foundation and floor. Bolts are needed to fasten sills for a wooden superstructure

CONCRETE WALKS AND STEPS

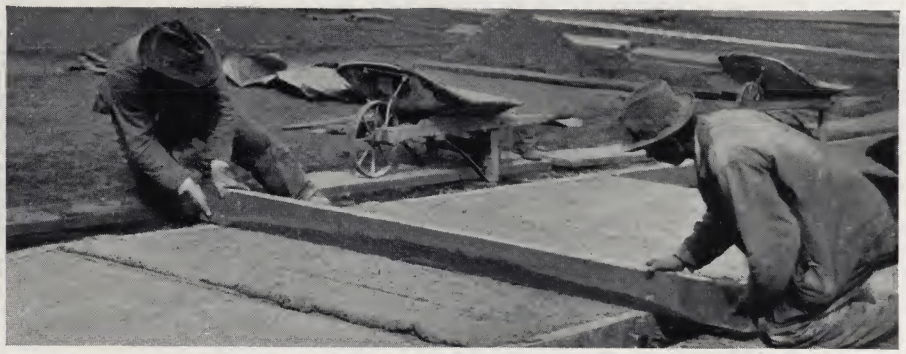
Sturdy forms for sidewalk construction can be made with 2 x 4 lumber. Note the division between each block



Alternate blocks are poured, using a 1: 2½: 4 concrete mixture (1 part cement, 2½ parts sand and 4 parts stone or gravel)

Division forms are then removed, the edges of the finished blocks are greased, and the remaining blocks are poured

Use water sparingly in mixing concrete. Within reasonable limits, the less water used, the better the concrete



Leveling concrete with a board, known as a screed. The surface is then finished with a wood float, which provides a gritty, non-skid surface. The walk should be cured for a week. As soon as concrete sets, cover with straw and sprinkle with water

Firm, solid walks from the house to the barn are a great convenience. They are permanent, and never need replacement

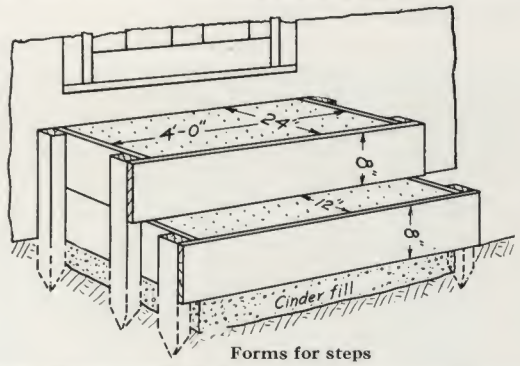
Concrete walks save many hours of labor for the women on the farm. They present a smooth, even, non-slip surface

Concrete walks are easily constructed; they are economical in upkeep, clean, safe and attractive

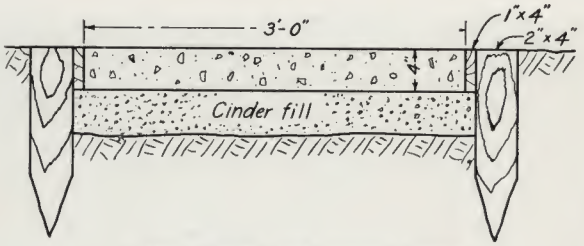
Walks, steps and retaining walls can often be combined in a practical and pleasing manner

The housewife will appreciate this easily cleaned back porch

Concrete steps have solved the problem presented here by a change in the road grade

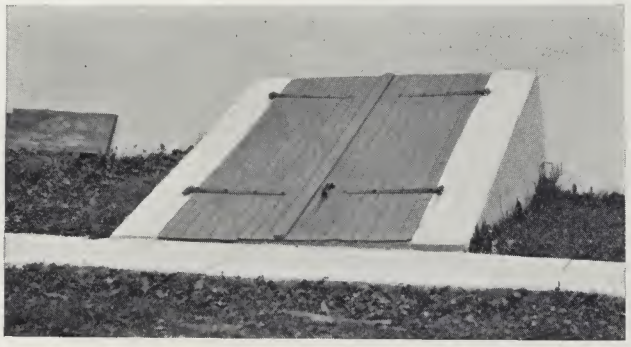


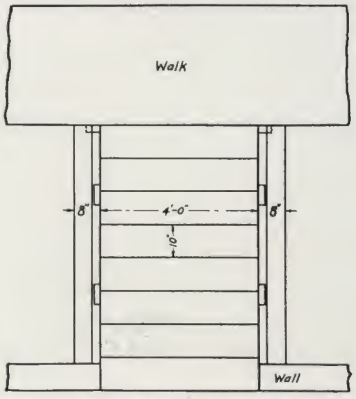
Forms for steps



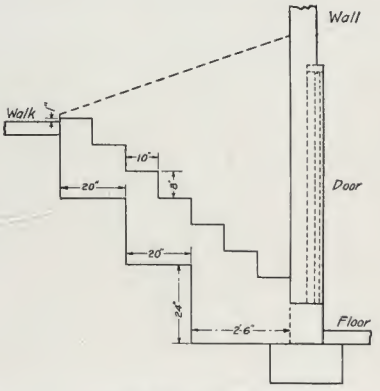
Cross-section of walk, showing forms

OUTSIDE CELLAR ENTRANCE

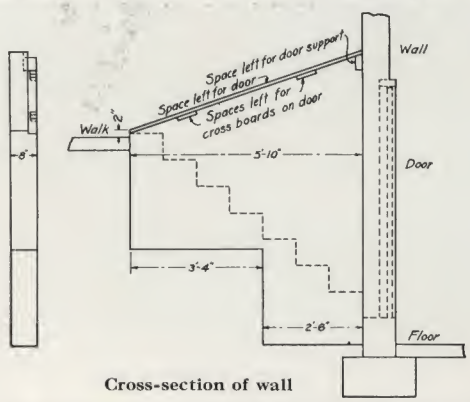




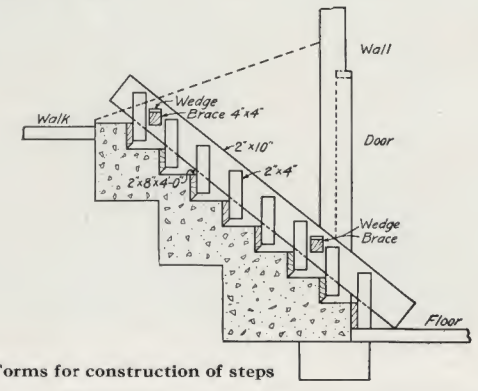
Plan of steps and walls



Cross-section of steps



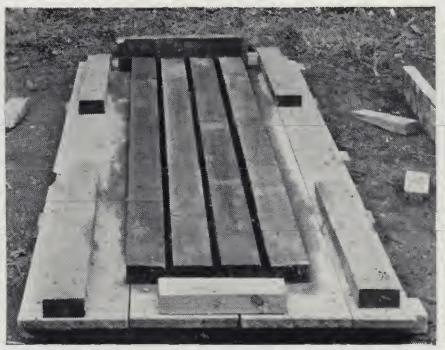
Cross-section of wall



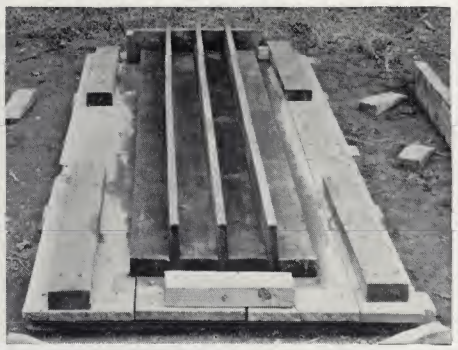
Forms for construction of steps

FENCE POSTS

Forms for fence posts are easily made. The mold illustrated here will cast four posts. The platform is 3 feet wide by 8 feet long

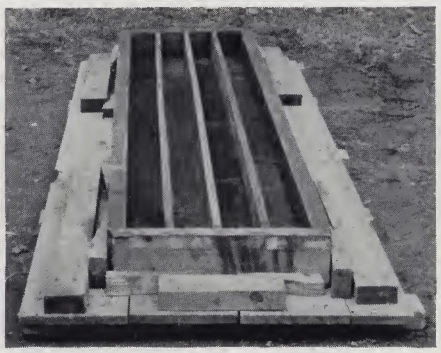


Four pieces of 2-inch lumber, 4 inches wide and 7 feet long, are placed on the platform. These form one side of each post

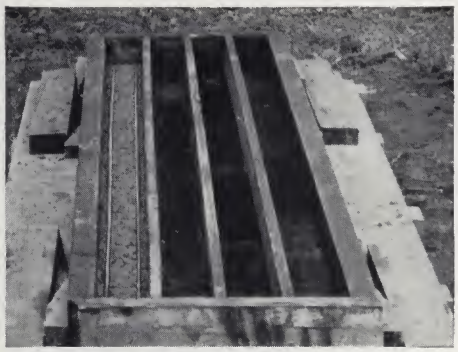


For separators between posts, strips of one-inch lumber, 5½ to 6¼ inches wide, are stood on edge

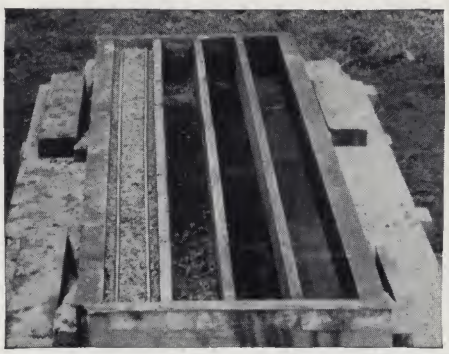
The difference of ¾ inch in the width of these strips tapers the posts. One end will be 4¼ inches wide; the other, 3½ inches



Forms complete. Prepare a 1:2:3 concrete mix made with small stone or gravel. Use water sparingly

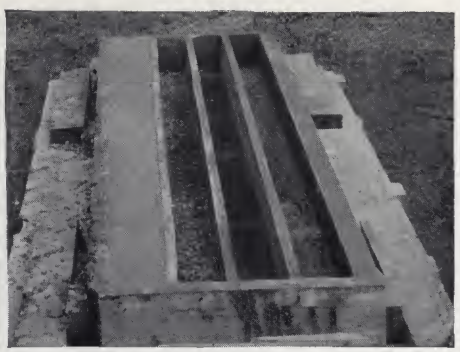


Place a one-inch layer of concrete in the molds. Tamp thoroughly. Put in two ¼″ rods for reinforcement



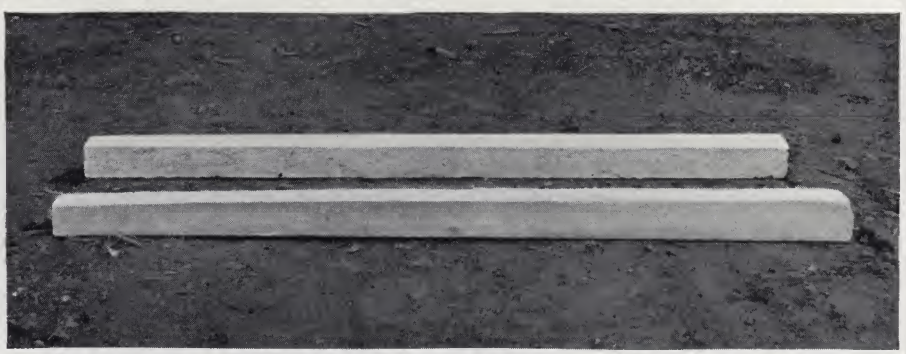
Fill mold with concrete to within 1 inch of top. Tamp concrete again. Place two more reinforcing rods in position

Place reinforcing about 1 inch from the outside of posts. If placed nearer the edge, rods will rust and concrete will break



Fill mold with concrete. Thorough tamping is necessary to obtain good posts. Finish with a steel trowel

Cover the entire form with straw or burlap, and keep wet by sprinkling until the posts are removed from forms

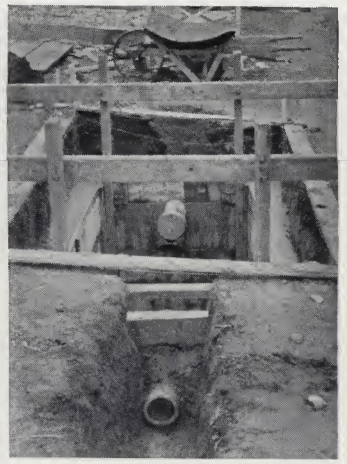


Thorough curing will add greatly to the strength of fence posts. Keep them covered with wet straw for ten days. Straw can then be removed and the posts stood on end. Thirty days later they are ready for use

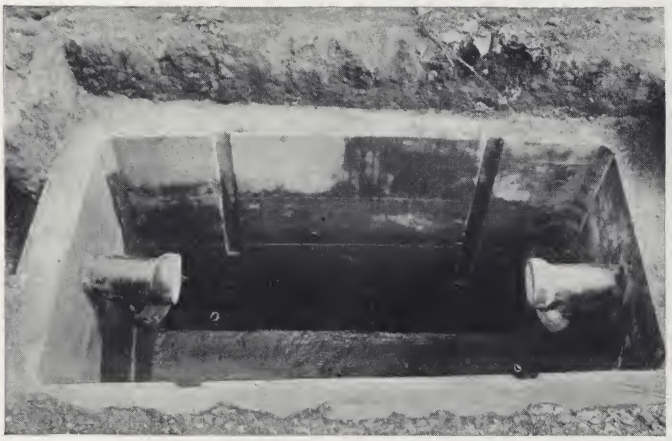
SEPTIC TANKS—Continued

Placing the concrete. A 1:2:4 mix is recommended, made very stiff. Pour walls first, and then the floor, in one operation. Tamp concrete continually while pouring

Y's are placed branch downward. They must not extend beyond baffle-board grooves

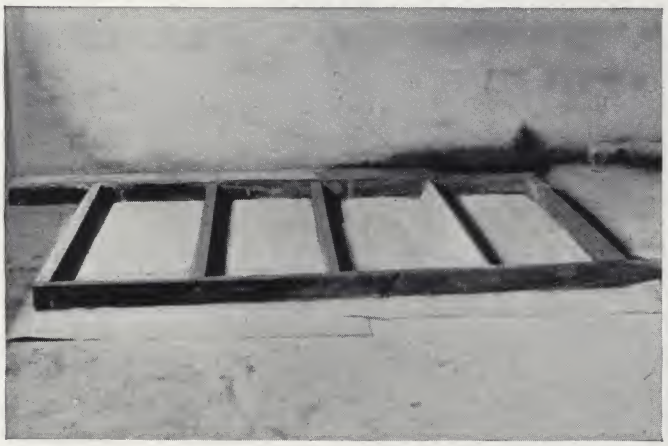


The concrete must be packed thoroughly under and around the Y-branches



Allow concrete to harden from five to seven days before removing forms. First remove center brace, then draw nails holding the 2 x 4 corners to the sides. Remove ends of forms, then the sides

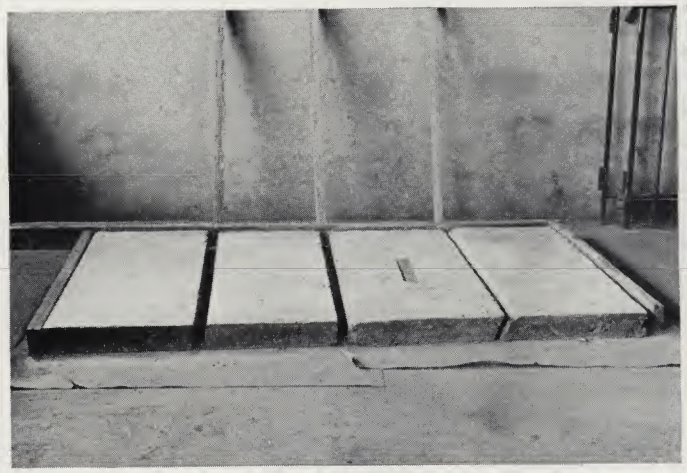
The baffle-boards, made of 2-inch planks, preferably of cypress or chestnut, can now be put in place and wedged tight. These baffles prevent a direct current from inlet to outlet



Forms for cover slabs are made of 2 x 4 inch lumber. Four sections are advisable because of the weight in handling. Note that one section is beveled to permit easy removal when cleaning tank

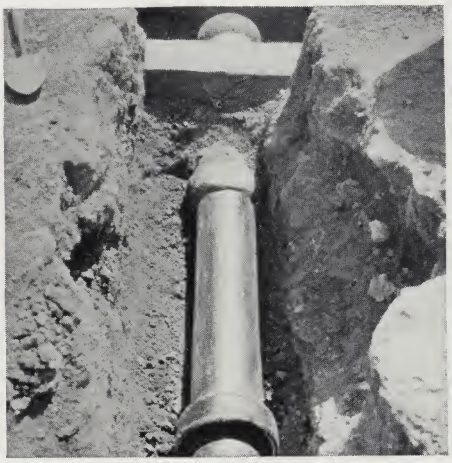
Fill forms with a mixture of 1:2:3 concrete. Reinforcement of half-inch bars or of expanded metal lath should be placed ¾ inch from the under side of the slab

SEPTIC TANKS—Continued



Forms removed from cover slabs. The beveled section has been marked "I" to identify it when it is necessary to lift covers to clean tank. This section can then be lifted off first

One of the cover sections in place. It is not necessary to seal the joints between the cover slabs, as the earth covering will aid in keeping the tank sufficiently air tight



Inlet line joining Y-branch. There is no bell at the tank joint, and a band of concrete is placed around the ends of pipe

Force a few strands of oakum or shredded tarred rope in bell end of sewer pipe before cementing the joint

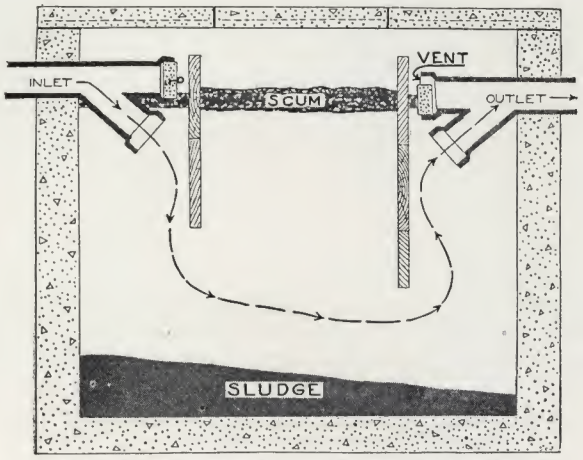
Pack joints of the sewer pipe with cement mortar. Best grade for inlet is ¼ inch to the foot. Too steep a fall should be avoided

Drainage line should have a fall of 2 inches in 100 feet. Use at least 100 feet of tile. More will be needed in poorly drained soil

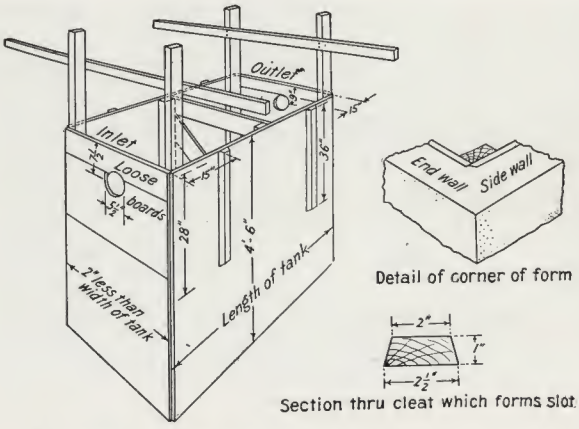
Farm drain tile, 3 or 4 inches inside diameter, one foot long, is used for outlet. Place tar paper over joints to keep soil out

The completed tank (without cover slabs), showing inlet line of sewer pipe and the outlet line of drain tile in place

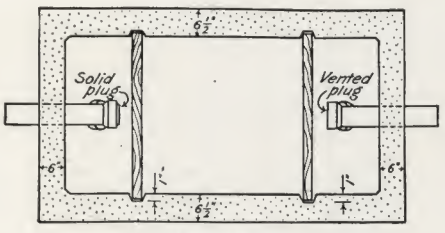
SEPTIC TANKS—Continued



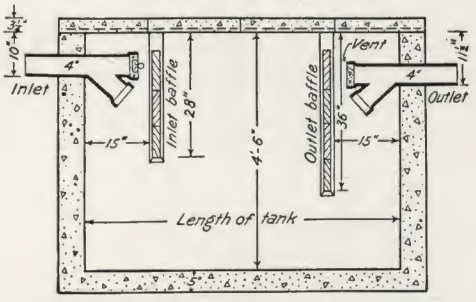
Section of tank in operation. Current follows dotted line. Because of action of bacteria, solids in the sewage are turned into liquid and gas



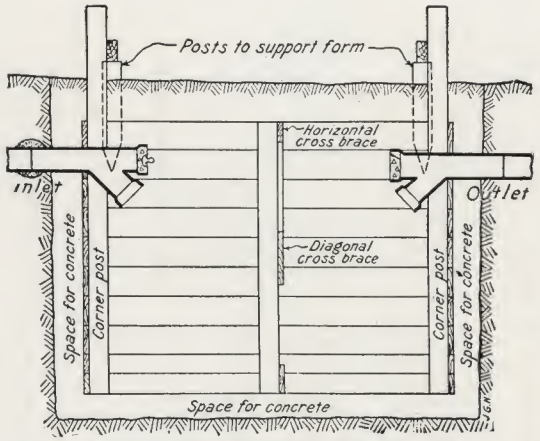
Forms for building tank. Dimensions of various sized tanks are given below



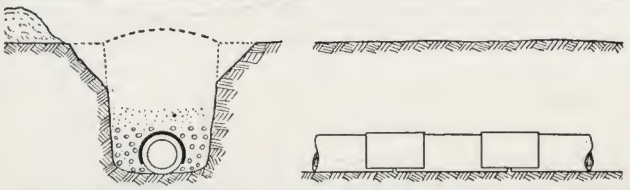
Plan of tank



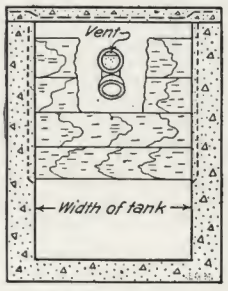
Section lengthwise



Forms in place, supported by cross-arms



Drain tile laid in trench. Tar paper placed over joints. Surround with gravel, and fill trench with soil



Cross-section

Inside Dimensions of Septic Tank			
No. of persons	Dimensions of tank		
	width	length	depth
6 or less	2½′	5′	4½′
8	3′	6′	4½′
10	3′	7′	4½′
12	3′	8′	4½′

Materials Required

Tank (Inside)	Size of Cover	Mixture	Concrete	Cement	Sand	Gravel
2½′x5′x4½′	. . . . .	1:2:4	48¼ cu. ft.	10½ sacks	⅘ cu. yd.	1⅜ cu. yd.
	3½′x6′x3¼″	1:2:3	7⅔ cu. ft.	1¾ sacks	⅛ cu. yd.	⅕ cu. yd.
3′ x6′x4½′	. . . . .	1:2:4	61 cu. ft.	13 sacks	1 cu. yd.	1⁹⁄₁₀ cu. yd.
	4′ x7′x3¼″	1:2:3	9⅘ cu. ft.	2 sacks	⅛ cu. yd.	¼ cu. yd.
3′ x7′x4½′	. . . . .	1:2:4	68 cu. ft.	14½ sacks	1¹⁄₁₀ cu. yd.	2¼ cu. yd.
	4′ x8′x3¼″	1:2:3	11⅕ cu. ft.	2¾ sacks	⅕ cu. yd.	³⁄₁₀ cu. yd.
3′ x8′x4½′	. . . . .	1:2:4	75½ cu. ft.	16 sacks	1¼ cu. yd.	2½ cu. yd.
	4′ x9′x3¼″	1:2:3	12⅔ cu. ft.	2½ sacks	¼ cu. yd.	⅓ cu. yd.

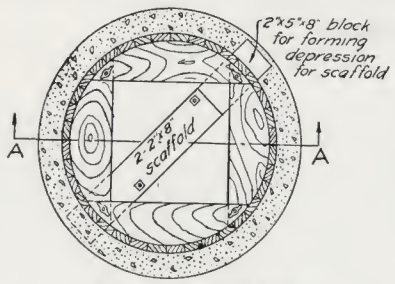
PLANS THROUGH COURTESY OF PENNSYLVANIA STATE COLLEGE

WELL COVERS AND LININGS

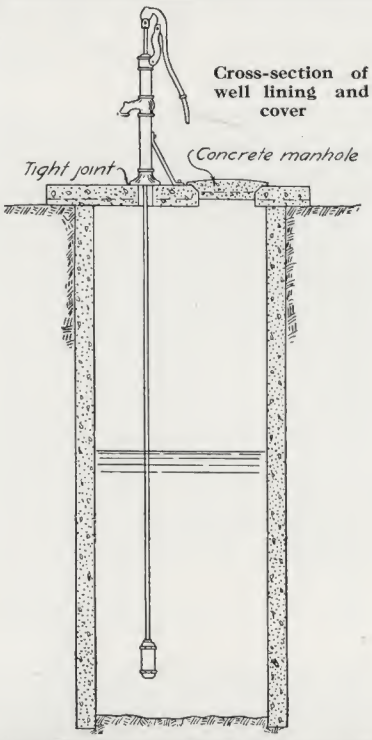
A concrete well lining and cover safeguards health by insuring the water supply against contamination from surface drainage

The large sizes of concrete pipe make an excellent lining as an alternative for poured concrete

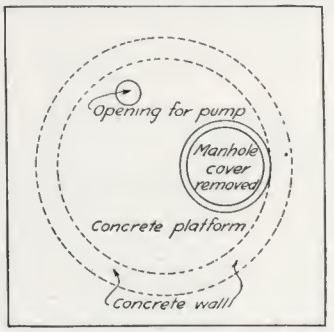
A 1:2:3 mix should be used for linings, as a watertight wall is necessary. A 1:2:4 mix is satisfactory for the reinforced cover slab



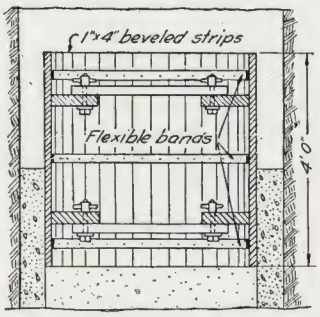
Sectional plan of lining



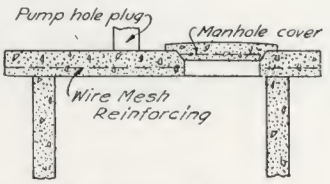
Cross-section of well lining and cover



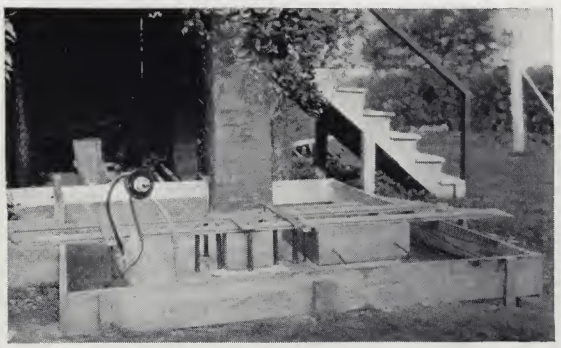
Plan of cover slab



Section A-A (omitting scaffold)



Section of cover slab



Concrete well cover, with electrically operated pump jack, enclosed in a shed for protection against weather. The illustration above shows the forms ready to receive the concrete

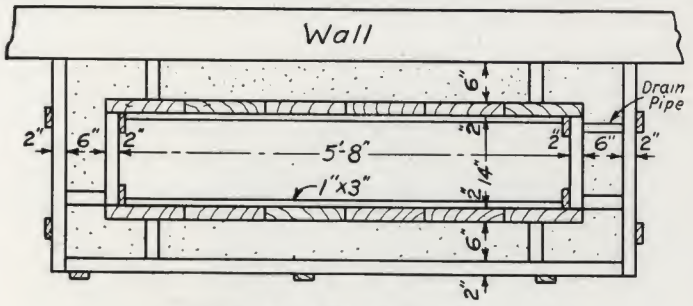
PHOTOGRAPHS THROUGH COURTESY OF U. S. D. A.

WATER TROUGHS

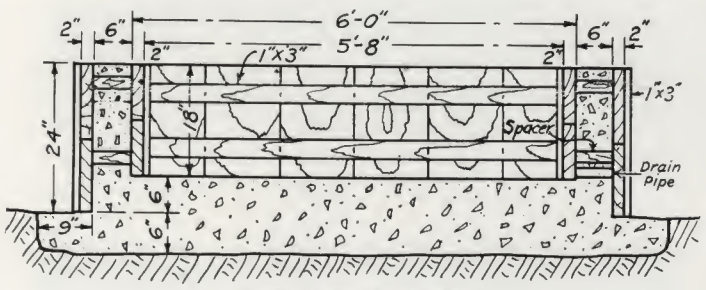
Forms for concrete water trough have been suspended from above and braced against the wall.

A 1:2:3 mixture will give water-tight concrete provided it is well tamped while being poured

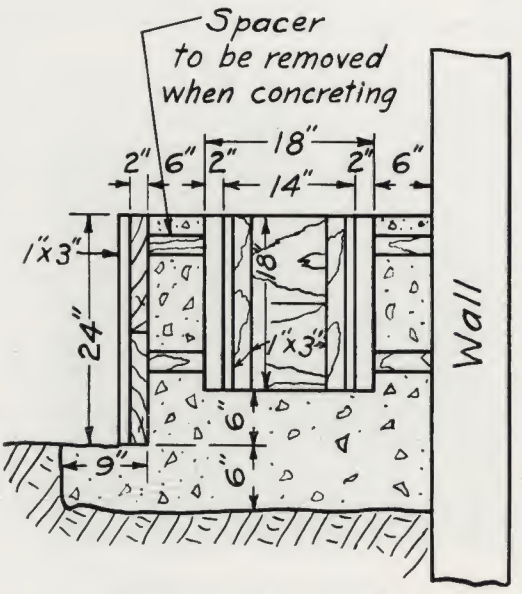
Remove inside forms in 24 hours and fill tank with water. Remove outside forms in one week. To remove the marks of the wooden forms, rub with an abrasive stone as soon as forms are off



Plan of concrete water trough

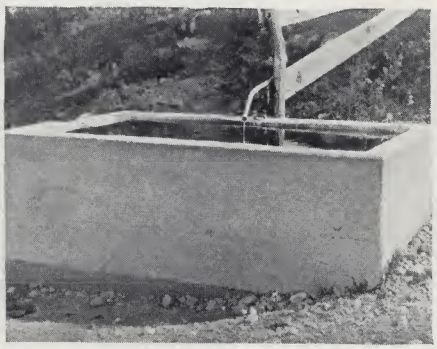


Cross-section lengthwise



Cross-section of end of trough

A concrete pavement around the water trough prevents the formation of an unsanitary mud hole



A trough placed to utilize the water from a hillside spring above it insures a constant supply for the stock

This concrete water trough has been conveniently located at a point where it will serve three pastures

BARN APPROACHES

A concrete barn approach is a worthwhile improvement. It keeps the soil in place during heavy rains and the concrete walls present a neat and attractive appearance

Reinforced suspended slab with ⅝ inch bars spaced 10 inches from center to center, placed 1½ inches from the bottom of the slab. Spans larger than 8 feet should be computed by an engineer

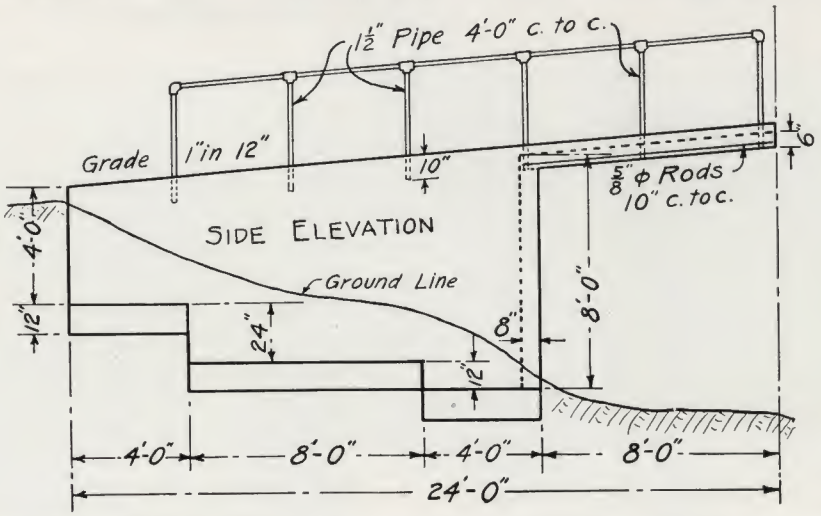
Materials Required

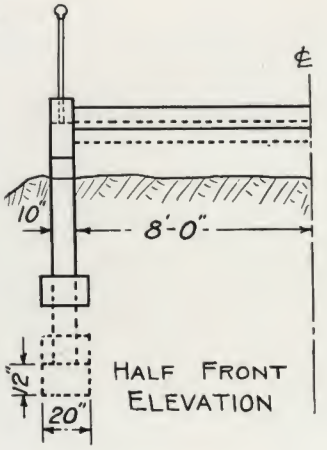
Footing
Mixture, 1:2½:5 Concrete, 2 cu. yds.
Lehigh Cement ..... 12 sacks
Sand, ¼ inch and under ..... ⅘ cu. yd.
Stone, ¼ inch to 1½ inches ..... 1¾ cu. yds.

Approach Walls
Mixture, 1:2½:4 Concrete, 150 cu. ft.
Lehigh Cement ..... 31 sacks
Sand, ¼ inch and under ..... 3 cu. yds.
Stone, ¼ inch to 1½ inches ..... 4⅔ cu. yds.

Slab, 8 feet x 16 feet x 6 inches
Mixture, 1:2:3 Concrete, 64 cu. ft.
Lehigh Cement ..... 24 sacks
Sand, ¼ inch and under ..... 1¼ cu. yds.
Stone, ¼ inch to 1 inch ..... 1⅞ cu. yds.
Reinforcement (24 pieces) ..... ⅝ in. x 8 ft. 6 in.

Pipe Railing
Uprights—12 pieces, 1½″ x 4′ 6″—Threaded one end
Railing—2 pieces, 1½″ x 20′—Threaded both ends
Connections 4 L ells 1½ inches x 1½ inches
8 T couplings, 1½ inches x 2½ inches x 2½ inches—for sleeve joint



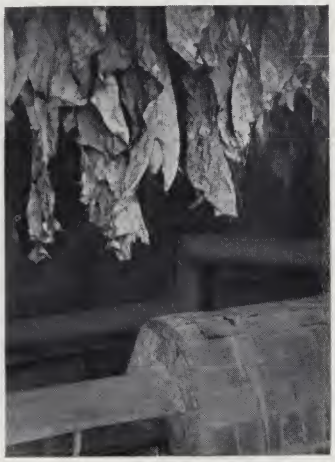


TOBACCO CURING BARNS

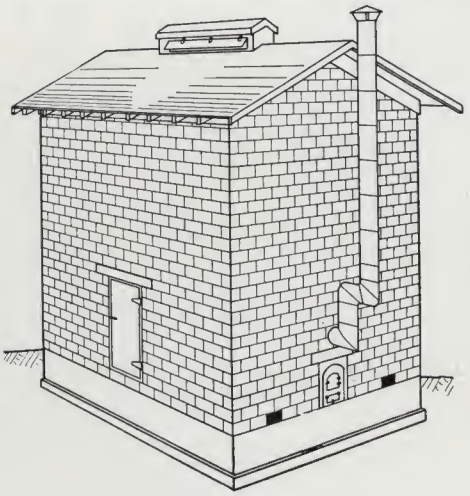
Tobacco Curing Barn built with concrete block. Excellent results have been obtained with this permanent and fireproof structure

View from furnace end of building. A shed has been erected for convenience in tending the fire in wet weather

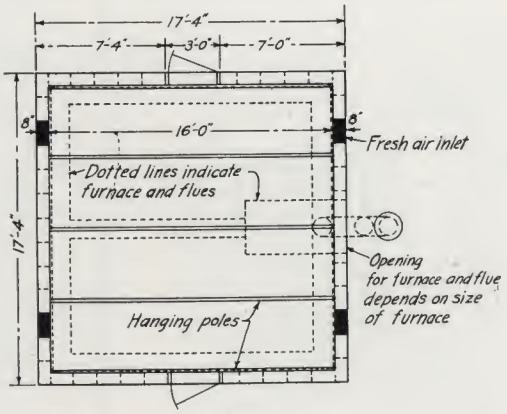
Furnace and flue. Note removable blocks in bottom course, for ventilation



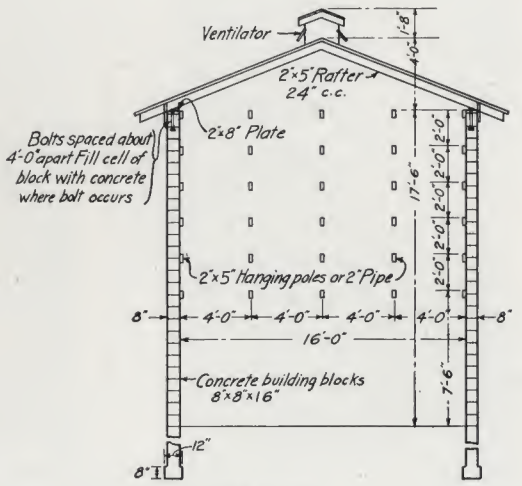
View through door at side of barn, showing tobacco hung on poles above heater



Tobacco Curing Barn

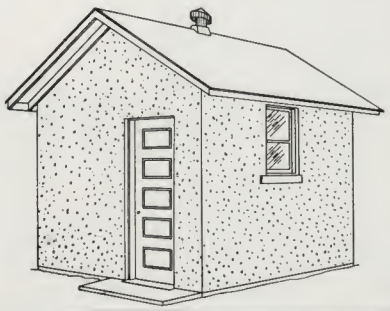


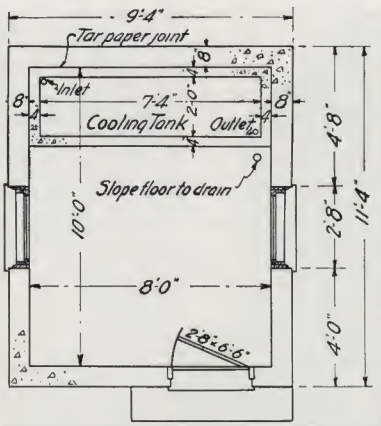
Plan

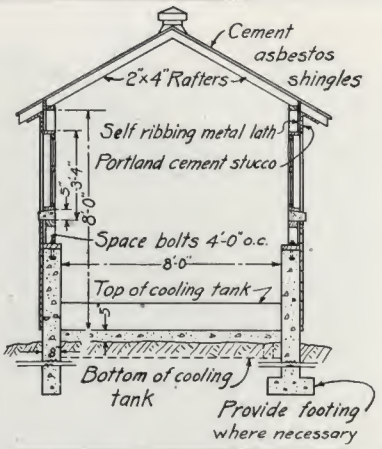


Cross-section

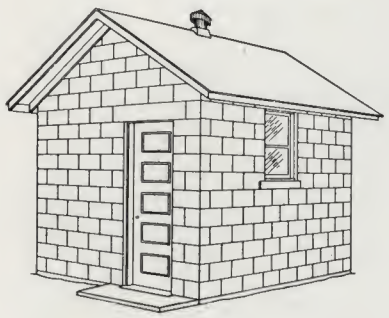
MILK HOUSES

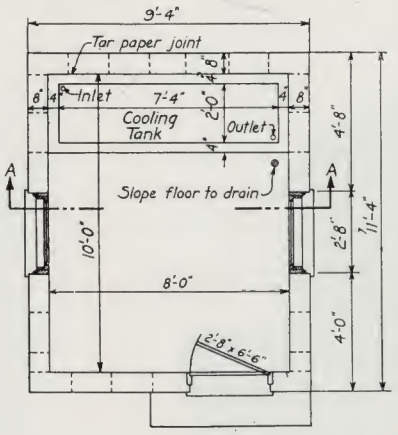


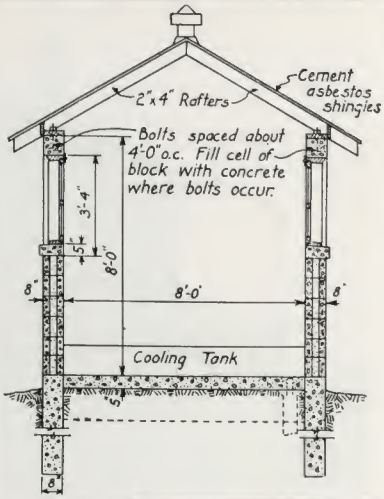




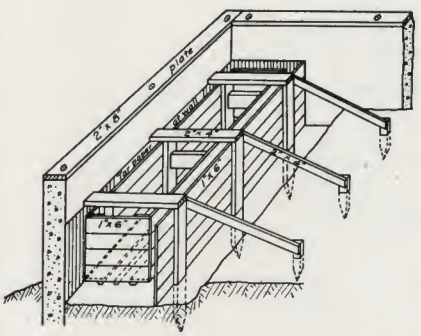
Plans for a monolithic concrete milk house with a stucco exterior. Foundations should be carried below usual frost line to prevent upheaval by freezing. If earth walls of trench are carefully dug, forms will not be necessary below surface. Forms for wall above grade should be made of 1 x 6-inch boards well braced. Use a 1:2½:4 mixture (1 part cement, 2½ parts sand and 4 parts of gravel or stone)

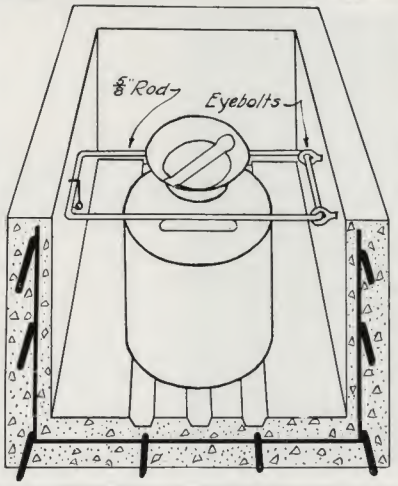


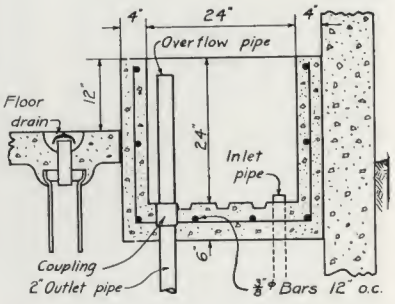




Plans for a concrete block milk house. Blocks are laid in a 1:3 Portland cement mortar (1 part cement and 3 parts of clean, well-graded sand). If stucco is not to be used, smooth-faced blocks are best. The floor of the house should rest on firm soil. Use a 1:2:3 concrete mixture. The full 5-inch thickness of concrete should be placed in one operation. Finish with a wood float

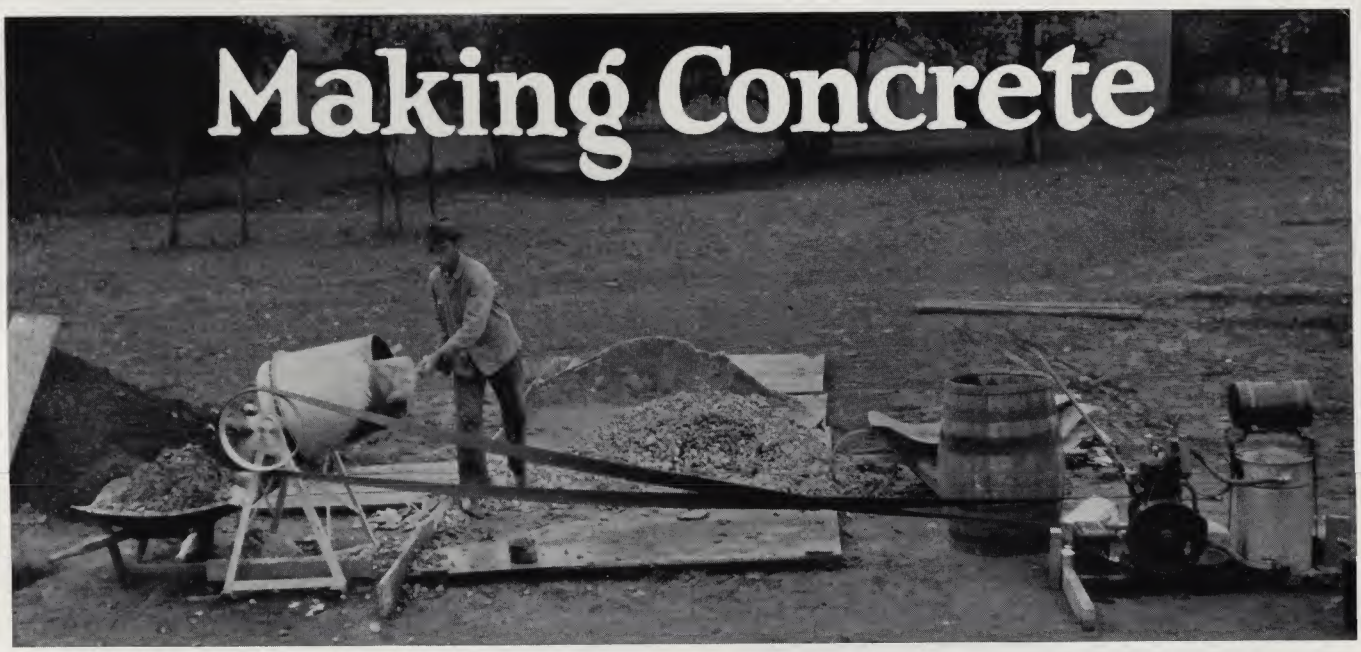






Details of construction for the milk cooling tank. Tank floor and sides are concreted in one operation. A 1:2:3 concrete mixture is recommended. It should be carefully tamped to insure a dense, watertight tank. Grooves in tank floor permit water to circulate under cans freely. Strips of wood are attached to bottom of inside form to shape these grooves

Making Concrete



MANY people believe that the quality of concrete depends entirely upon the cement used. It is true that a high quality cement—Lehigh Portland Cement—should be used, but of equal importance are the selection of the other materials and the care exercised in the mixing.

Good concrete can be made by following these directions:

1. Specify "Lehigh" Cement.
2. Use clean, well-graded sand and stone.
3. Mix properly and completely.
4. Place carefully.
5. Use care while curing and drying.

Concrete is a product resulting from the proper mixture of cement, sand, stone or gravel, and water. Cement acts as a mineral glue, binding these materials firmly together.

Materials for Concrete

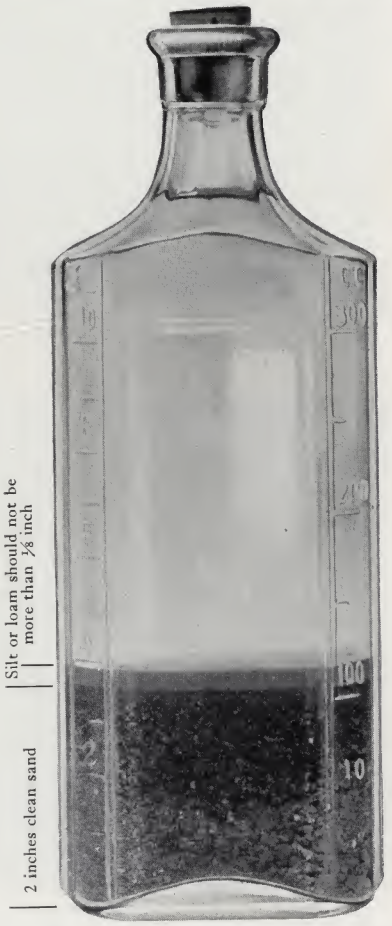
Sand, gravel, and stone vary in quality and must be selected with care. Sand is often dirty, due to the presence of foreign materials, such as silt or organic matter. Rotted vegetable material may be present in such a fine form as to be difficult to detect; or considerable clay may be in the sand. Practically the same impurities may be found in gravel or crushed stone, particularly in gravel. The pebbles may be coated with clay and foreign material, which will prevent the cement from binding the mixture firmly together as a mass.

Practically every gravel bank contains more sand than pebbles; in fact, the case is usually the reverse of what is best in making good concrete. It is highly desirable that a one-quarter-inch screen be used to separate the sand from the gravel. By so doing the proportions can be quickly gauged to conform to the requirements of the work at hand.

The usual proportions of concrete mixture require approximately twice as much gravel as sand, and a gravel bank which will produce such a proportion is almost unheard of. In concrete work, material that will pass through a one-quarter-inch screen is called sand. Material that will not pass this screen is called gravel. Therefore, if it is not possible to screen all the sand from the gravel, tests must be made regularly to determine the average gravel and sand content of the run-of-bank material. This having been done, the proportion can be varied accordingly, which will provide a satisfactory mixture for the average small job.

A test to determine the presence of loam or organic matter in sand is easily made. Obtain a 12-ounce graduated bottle and fill to the 4½-ounce mark with the sand to be tested. Add to this a 3% solution of caustic soda (one ounce of caustic soda dissolved in 32 ounces of water will make a 3% solution), until the combined volume of sand and solution amounts to 7 ounces.

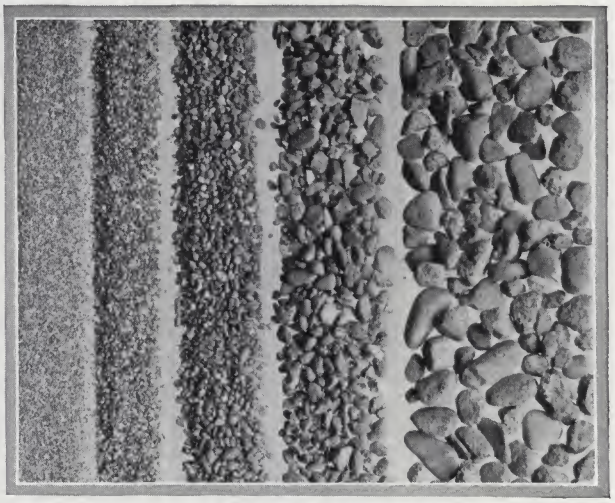
Shake thoroughly for a few minutes, and let stand for twenty-four hours. At the end of this time observe the color of the liquid above the sand. If the liquid is colorless or nearly so—a pale yellowish color—the sand is sufficiently free from organic impurities for use in high-grade concrete. A brownish-yellow liquid, or one darker than a pale straw, indicates a sand which should not be used in important concrete work, such as roads, pave-



Test to determine presence of silt or loam in sand

SAND

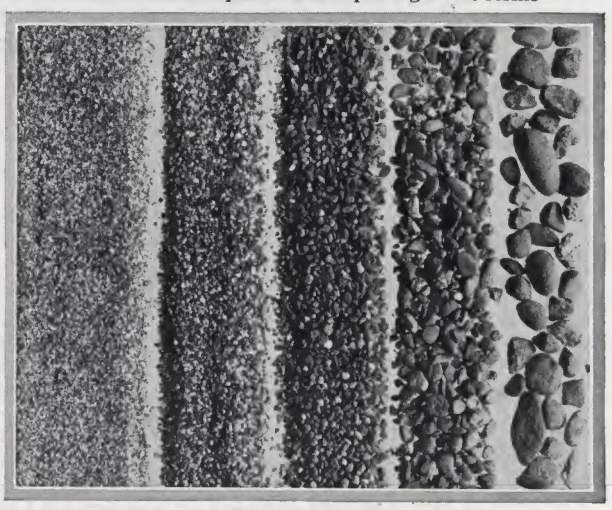
Coarse Sand, an Actual Sample, Full Size



Same Sample, Screened

In the panel to the right the grains have been separated to show the proportion and the range in size of particles. This is about as coarse as sand should be for use in concrete. It gives good strength, but makes a harsh mixture which requires careful placing in the forms

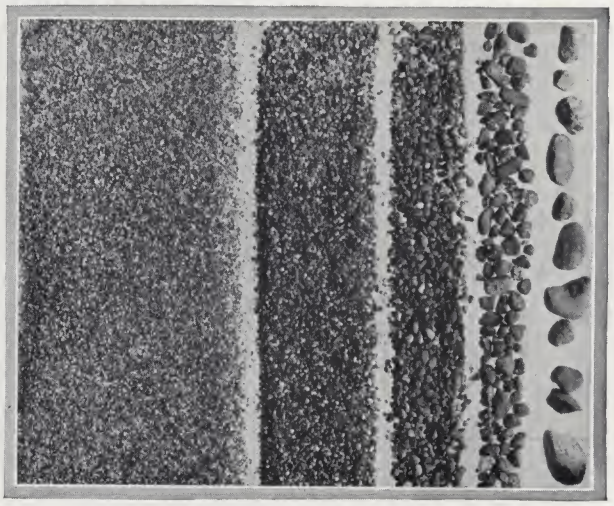
Medium Sand, an Actual Sample, Full Size



Same Sample, Screened

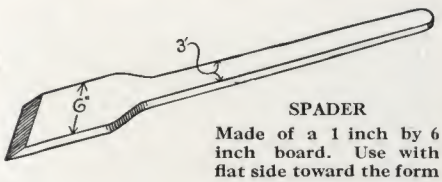
In the panel to the right the grains have been separated to show the proportion and the range in size of particles. This is almost an ideal sand for use in concrete, containing the same volume of grains of different sizes, and will give excellent results

Fine Sand, an Actual Sample, Full Size



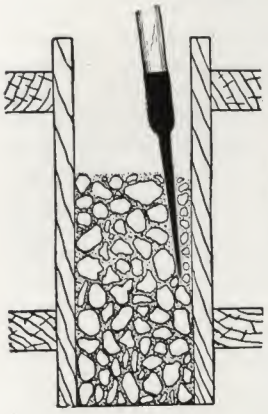
Same Sample, Screened

In the panel to the right the grains have been separated to show the proportion and the range in size of particles. This sample has a large proportion of fine grains and is about as fine as sand should be for use in concrete to obtain best results



SPADER
Made of a 1 inch by 6 inch board. Use with flat side toward the form

WOOD FLOAT
For producing a rough sand finish on concrete surfaces



SPADING concrete next to the form causes the concrete to settle to its greatest density

ments, and reinforced concrete building construction. If the color of the liquid is brownish throughout, the sand may be used in unimportant work only, such as footings or foundations that are not to carry heavy loads. A dark brown liquid shows a sand which should not be used for concrete work unless it can be washed to remove the foreign materials.

A very simple test to ascertain if the sand is free from silt or earth is made by placing two inches of sand in a bottle, fill with water, shake thoroughly for a few minutes, then allow to settle. If, after settling, there is 1/8 inch or more of sediment above the sand, washing is advisable.

Sand can be washed on an inclined platform 10 to 15 feet long, with a slope of 12 to 18 inches. Strips at sides and end will keep sand from washing away. A stream of water running through the sand from the upper end over the baseboard will remove the dirt. Pebbles and screenings from crushed stone can be washed in a similar manner.

Where bulk is required, and no great tensile strength is needed, hard cinders from soft coal are often used in place of gravel or stone in order to reduce the dead weight of the construction. For roof slabs on short spans and for base courses under cement finish, cinder concrete will prove economical. Due to the greater percentage of voids in cinders, a slightly increased amount of mortar (sand and cement) must be provided.

Within reasonable limits, the strength of the concrete increases with the size of the stone or gravel. In the general run of concrete work, including thin reinforced sections, the size should not exceed 1 or 1¼ inches. In mass concrete, such as heavy foundations and thick walls and floors, the size of the stone or gravel may often range up to 2½ or 3 inches. Round or egg-shaped particles of stone or gravel pack more closely and produce better concrete than flat, elongated pieces.

Forms for Concrete Construction

For most concrete work, the forms are easily made. A concrete walk or driveway, for example, requires 2 by 4-inch or 2 by 6-inch side strips to form the edges, and cross-pieces to limit the size of the various slabs into which the walk or drive is divided. In setting these forms it is necessary to level their upper surface or, if the work is not intended to be exactly level, then to set them so that the finished concrete surface will have the grade or slope desired.

Spruce and Norway pine is acceptable lumber for making forms and is reasonable in cost. For form work which requires great precision, such as window-sills and lintels and other pieces of ornamental concrete, white pine will be found the best lumber to use. Hemlock is not very satisfactory for form work, as it splits and curls very easily.

All form lumber, regardless of where it is to be used, should be resurfaced on one side and one edge. In so doing the lumber will work much easier and will also provide a more satisfactory appearance. Lumber which is surfaced will make a much tighter form and will hold all the cement and sand, avoiding the possibilities of rock pockets and rough surfaces in the concrete. Ship lap or tongue and grooved lumber is most satisfactory.

For such concrete work as foundation walls below ground level, forms are unnecessary if the earth is firm enough to stand without caving. It is well to lay a plank along the edge of the trench, to assist in holding the bank upright, and to prevent the soil caving and mixing with the fresh concrete.

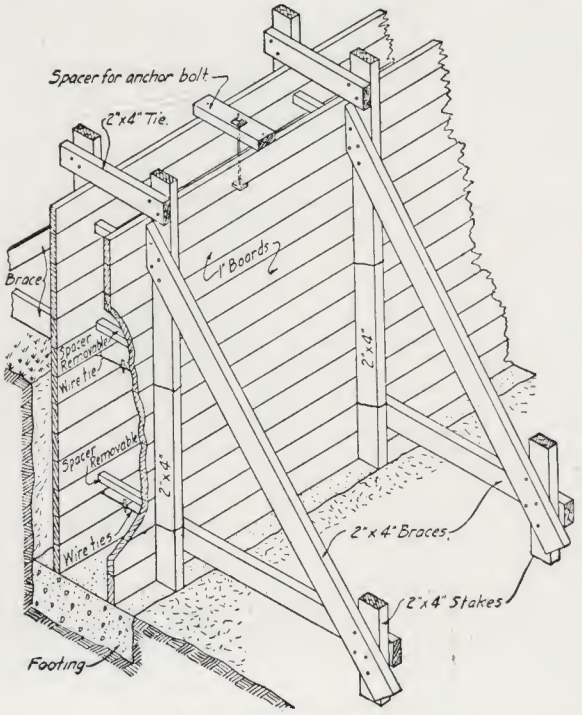
Good workmanship on forms is important because the appearance of the finished work is governed by the care with which forms are made and set up.

Considerable economy results from planning forms carefully before cutting lumber. Planning involves careful study of the working drawings of the structure or object to be built. It should be remembered that the inside surfaces of the forms lie against the concrete and thus reproduce the design, shape, or details intended. A projection designed on the structure calls for a depression in the face of the form to produce that projection. In other words, the form surface or interior face must be the reverse of the finished concrete surface or face.

For silos, grain tanks, chimneys, and other circular structures, as well as certain rectangular ones, metal forms have been devised. Such forms are in general use by silo builders and by building contractors specializing in concrete construction.

To assist in salvaging the forms, use as few nails as possible, and do not drive them home. The forms can then be quickly removed and the lumber is available for other work.

It is customary to wet the forms during extremely dry weather before placing the concrete. This prevents the dry lumber from absorbing water from the concrete mixture, thereby depriving it of the moisture necessary for proper hardening.



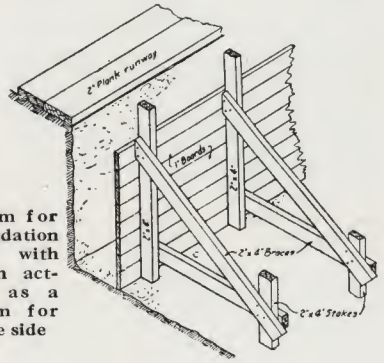
Typical form construction

AREAS AND WEIGHTS OF REINFORCING STEEL

Size—Inches	⅜	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
Round Bars—Lbs. Per Foot...	.042	.167	.376	.668	1.043	1.502	2.044	2.670	3.380	4.172	5.049	6.008	7.051	8.178	9.388	10.681
Square Bars—Lbs. Per Foot...	.053	.213	.478	.850	1.328	1.913	2.603	3.400	4.303	5.313	6.428	7.650	8.978	10.413	11.953	13.600

Removal of Forms

There is no set rule for the removal of forms. Under normal conditions forms are often removed within two days. It is much better, whenever possible, to allow



Form for foundation wall with earth acting as a form for one side

them to remain much longer, as they assist materially in the proper curing and strengthening of the concrete.

To prevent concrete from sticking to small wooden molds, saturate them with crude oil. Oil drained from the crankcase of an automobile is also satisfactory for this purpose.

Back filling of earth should not be done in any case before a week has elapsed. Many excellent concrete jobs have been ruined by early back filling which has caused a terrific strain to be exerted against the comparatively green concrete. This often develops cracks which are both unsightly and unsatisfactory from a waterproofing standpoint.

Reinforcing Concrete

Reinforcement is needed for concrete subjected to strains other than those of compression. The compressive strength of concrete is approximately ten times its tensile strength. Reinforcing metal of suitable size and shape, properly embedded in the concrete, will provide the necessary tensile strength for beams, overhead floors, walls, tanks, silos, or any other structures which carry loads. Concrete properly mixed and well placed adheres to steel and forms a firm bond. When loads are applied, the steel immediately takes its share of the strain. Reinforcing may be in the form of round, square, or deformed steel bars, or various kinds of expanded metal or wire mesh. The object of deforming the bars, either by lugs or depressions in the surface, is for the purpose of increasing the "mechanical bond" between concrete and steel.

Reinforcing must be free from rust, grease, or any other foreign substance that would prevent the concrete from adhering to it. All rust in the form of dust, and particularly scale, should be removed with a wire brush. The bending of reinforcement should be done gradually, in order that its strength will not be impaired by small fractures. Steel reinforcing rods of all shapes and sizes may be obtained in most any hardware store. Mesh reinforcing, used to a great extent for slabs and floors, comes in rolls.

To give the desired strength, reinforcement should be placed in exactly the position called for by the plans. The ends of mesh should be overlapped 4 inches or more and bound together securely by wire so as to prevent displacement during placing of concrete. Rods should be lapped about 30 times their diameter.

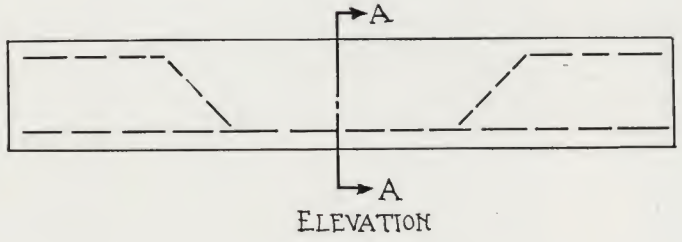
Steel is used instead of other metal for reinforcing concrete because it has practically the same ratio of expansion as concrete. In other words, all substances expand and contract under changing temperature conditions, and the rate of expansion in steel and concrete is so nearly the same that the bond between the concrete and steel is not broken.

For work of any great importance, or where it is necessary to suspend a thin section of concrete, which for that reason will require reinforcement, it is well to consult with an engineer who will design the reinforcing to provide for dead and live superimposed loads and eliminate the chance of failure due to faulty design.

Reinforcing steel is usually sold by the pound, and the table given above will assist in determining the number of pounds of steel which will be required.

Proportioning Concrete

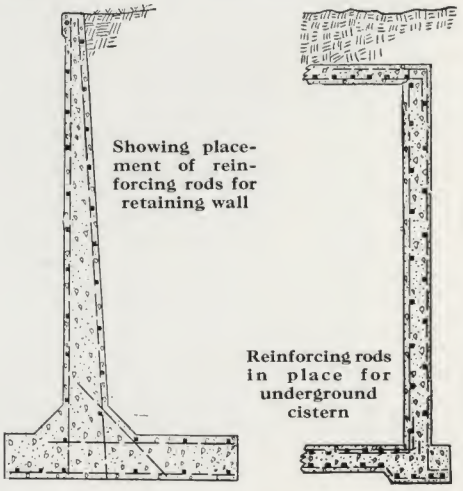
Concrete mixtures are specified as 1:2:3, etc. These figures represent the volume of each of the three materials used, always in the following order—cement, sand, and stone. Thus, a 1:2:3 mixture would be 1 bag of cement (which contains 1 cubic foot), 2 cubic feet of sand, and 3 cubic feet of gravel or stone.



ELEVATION

Section A-A

Concrete beam supported on both ends. Rods placed along bottom, where tensile strength is required. Alternate rods bent up as some pull occurs at the top, near supporting points



Showing placement of reinforcing rods for retaining wall

Reinforcing rods in place for underground cistern

A mixture of 1:2:3 gives a very dense, strong, and waterproof concrete, suitable for cisterns, tanks, and work subjected to unusual stress, wear, or moisture exposure.

A 1:2:4 mixture produces concrete of quite high strength and waterproofness.

The mixture of 1:2½:4 concrete will be found easy to work and place in the forms, and it does not leave as many rock pockets against the wall as is usual with a mixture which contains less sand. Its strength will be found very nearly that of a 1:2:4 mix, and for sidewalks and similar work it will finish nicely without the addition of any mortar or granolithic surfacing. In this way a rough, gritty surface is obtained with a minimum of labor and material.

A mix of 1:2½:5 is suitable for footings and walls thicker than 6 inches. Any mix in which the cement proportion is lower than this can be used only where mass and not strength or watertightness is required.

Mixing Concrete

If concrete is to be mixed by hand, a water-tight mixing platform is needed, about 8 by 10 feet, large enough for two men to work upon at one time. It can be made of 1- or 1¼-inch surfaced lumber, tongued and grooved, and free from knots. Tight joints are necessary to prevent loss of cement when water is added. A strip around the edge about 2 inches high will prevent loss of materials.

An ordinary water bucket of 12-quart capacity provides a convenient means of measuring quantities, or a measuring box 12 by 12 by 12 inches (inside measurements), without a bottom, will hold one cubic foot. If the box is used, the cement need not be measured, as each sack contains one cubic foot.

Measure sufficient sand for one batch and spread over the board to a depth of 3 or 4 inches. Then spread the cement as evenly as possible over the sand, and turn over both cement and sand with a shovel until all streaks of brown and gray disappear and the color is uniform. Measure the desired quantity of pebbles or broken stone and spread in a layer on top of the cement and sand. Mix all the materials thoroughly by turning several times with a shovel. Make a hollow in the center of the pile and add water while mixing until the desired consistency is obtained.

Avoid using too much water in mixing. Excess water weakens concrete. The concrete should always be wet enough to bring water to the surface with moderate spading.

A moderately wet mix, just wet enough to run off a shovel or pour from a wheelbarrow or bucket, is best for pouring into forms and for reinforced concrete work in which the steel must be perfectly embedded.

A quaking or jelly-like mix (one that trembles when spaded) is required for floors, driveways, and pavements. The quaky mix is preferable wherever it can be used.

Thorough mixing increases the strength of concrete, and a small power-operated mixer will reduce labor cost and give better concrete.

Placing Concrete

Concrete commences to harden very shortly after the water is added, and should be placed in the forms as soon after mixing as possible, in order that it may assume the shape intended. It is

Volume of concrete from various mixtures made in batches, each containing one sack of cement

Mix	Cement	Sand	Pebbles or Stone	Volume of Concrete
Cement, sand, and pebbles in order given	Sacks	Cubic feet	Cubic feet	Cubic feet
1:1½:3	1	1½	3	3½
1:2 :3	1	2	3	4
1:2½:3	1	2½	3	4¼
1:2 :4	1	2	4	4½
1:2½:4	1	2½	4	4⅘
1:2½:5	1	2½	5	5⅗
1:3 :6	1	3	6	6½

TABLE OF CONCRETE MIXTURES

	Mixture	Maximum Size Stone or Gravel
Barnyard pavements	1:2½:4	1½″
Building walls above foundation, when stucco finish will not be applied	1:2½:4	1½″
Concrete floors	1:2½:4	1½″
Concrete roads and pavements	1:2:4	2½″
Concrete steps	1:2:4	1″
Construction subjected to water pressure, such as reservoirs, tanks, and cisterns	1:2:3	1″
Corn-crib floors	1:2½:4	1½″
Culverts, dams, small retaining walls	1:2:4	2″
Dairy barn floor	1:2½:4	1½″
Dipping vats	1:2:3	1½″
Feeding floors	1:2½:4	1½″
Fence posts	1:2:3	½″
Foundations for engines subjected to heavy loading, impact, and vibration	1:2:4	2″
Foundations for small engines	1:2½:5	2″
Grain-bins, elevators, and similar structures	1:2½:4	1½″
Hog-house floors and foundations	1:2½:4	1½″
Hog wallows	1:2:3½	1″
Hotbeds and cold frames	1:2½:4	1″
Manure pits	1:2½:4	1½″
Manure pit floors and walls	1:2½:5	1½″
Mass concrete—large retaining walls, heavy foundations and footings	1:3:6	3″
Mass foundations	1:2½:5	3″
Milk-house floors	1:2½:4	1½″
Milk-house walls	1:2½:4	1½″
Pavements	1:2½:4	1½″
Poultry house floors and foundations	1:2:3½	1″
Reinforced concrete roof slabs	1:2:3	1″
Reinforced concrete walls, floors, beams, columns, and other concrete members designed in combination with steel reinforcing	1:2:4	1″
Septic tanks	1:2:4	1″
Sidewalks	1:2½:4	1½″
Silos	1:2:3	1½″
Smokehouses	1:2:4	1″
Stable and barn floors	1:2½:4	1½″
Steps and stairways	1:2½:4	1″
Walls above ground	1:2:4	1½″
Walls of pits or basements exposed to moisture	1:2:3	1½″
Watering troughs and tanks	1:2:3	1″
Watertight walls	1:2:3	1½″
Well covers, reinforced	1:2:4	¾″
Well linings	1:2:3	1″

MIXING CONCRETE BY HAND

Measure sand and spread over board to a depth of 3 or 4 inches

Spread cement as evenly as possible over the sand

Turn over both cement and sand with a shovel until color is uniform

Add desired quantity of pebbles or broken stone, and mix thoroughly

Make a hollow in the center of the pile and add water

Mix until desired consistency is obtained, adding more water if necessary

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convenient to have the mixing operation carried on near the place where the concrete is to be deposited.

When concrete is being placed in an excavation for a foundation wall, place boards or planks along and across the trench so that workmen wheeling barrows loaded with concrete can dump the concrete without breaking down the trench sides. Concrete should be deposited in layers of uniform thickness throughout the enclosure made by the forms. From 6 to 8 inches is the greatest depth that should be placed at one time, because a layer of greater thickness cannot be compacted by spading or tamping.

Concrete placed in forms should be consolidated by spading, but spading against the form itself brings to the outside of the wall a skin coat of a very rich mixture which will shortly develop hair cracks. These mar the appearance of the structure and are by no means easily eliminated. The proper method to insure satisfactory tamping and provide a surface free from rock pockets and air holes is to spade lightly an inch or so away from the wall surface. This will cause the concrete to settle into place with no appreciable amount of disturbance.

When concreting troughs, watering tanks, silos, and other structures which should be both air- and water-tight, concreting should be carried on as continuously as possible in order to eliminate construction seams. Many jobs cannot be completed within a working day. Work stopped for the day must be left in such condition as to make it easy to resume later without leaving a poor bond or the effect of a seam. This is usually done by roughening the concrete in the form when work is stopped, then immediately before resuming work painting the old surface with a paint made of cement and water, mixed like thick cream, and applied with a broom or swab. Immediately following this, place the concrete in the regular way.

Between narrow forms concrete has to be placed in thin layers because of the difficulty of spading in the narrow space. Under such conditions only one side of the form should be boarded up to full height, leaving the other side to be boarded as concreting progresses.

For all work where a non-slip surface is desired, such as walks, steps, and floors, the concrete should be finished with a wood float, which will give a slightly rough finish. This is particularly advisable in a stable or dairy barn, as the floors are often wet.

Water tanks, milk cooling tanks and similar work are more sanitary when finished with a steel trowel. The smooth, hard finish is also more impervious to water.

Curing Concrete

The hardening of concrete is not a drying process. It is the combination of water with cement which causes concrete to harden. Forms are often taken down and the work exposed to wind and sun in the belief that such treatment is an aid to thorough hardening. This practice deprives the concrete of a great deal of added strength that proper protection would have given it. Exposure to drying influences weakens concrete structurally and deprives concrete floors, walks, and other work of strength that would increase wear resistance. Keeping concrete damp the first ten days will give 65 per cent. increased strength and hardness. Three weeks' protection will give a still greater increase.

The forms furnish a measure of protection to concrete walls above ground.

The earth of a foundation trench in contact with the concrete provides all the protection the foundation needs while curing. Work above ground, however, should be wet down for several days by drenching it with water, in order thoroughly to harden the concrete. Floors, sidewalks, street and road pavements are protected by a layer of moist earth, sawdust, or other moisture-retaining material applied as soon as it can be placed without marring the surface of the concrete. The best method of protecting pavements and other flat surfaces is to place a small ridge of clay around the edge and flood with water.

Walls can be covered with canvas or burlap and sprinkled with water several times a day.

During moderate weather, where floors are being laid indoors, the enclosure formed by the structure makes extreme measures of curing unnecessary. However, occasional sprinkling of the concrete surface for several days will increase its strength.

Curing is well repaid in the greater strength, durability, and wearing resistance of the concrete, particularly in the case of driveways, walks, and other work subjected to heavy travel.

Waterproofing Concrete

Concrete that is correctly proportioned, thoroughly mixed, properly placed, and well protected while curing will be watertight.

Hydrated lime is often used in the mixture as a waterproofing agent, in proportion of one-tenth part of lime to one of cement. It also is useful in increasing the workability of the mix.

Asphalt and coal-tar are sometimes used for waterproofing, particularly as applied to the outside of foundation or basement walls. They are applied hot with a mop. Several coats are usually given.

Failure to make some classes of construction waterproof can be remedied by various after-treatments. If leakage from a cistern or tank consists merely of slight seepage through the walls, a coat of cement mortar (sand and cement) may be applied to the interior of the tank. The surface must be thoroughly cleansed by scrubbing it with water and a good stiff wire-brush. If scrubbing will not clean the surface, then the cement film should be removed by applying a wash of one part muriatic acid to three or four parts of water, allowing this to remain for but a very few moments and then *thoroughly* rinsing with clean water. Immediately before applying the plaster coat the cleansed surface should be painted with cement and water mixed to the consistency of cream. This can be applied with an ordinary brush and the plaster should be spread on immediately and worked in place vigorously before this wash has commenced to harden.

Plastering will not remedy cracking due to deficient and ineffective reinforcement. The only way to repair such a structure is to use the old tank as a form and build a new reinforced concrete lining within it.

Cracks in tanks or troughs can be repaired by cutting out each side of the crack to form a "V"-shaped groove 1½ inches deep and about 1 inch wide at the surface. Calk this groove with oakum soaked in tar until half filled, and finish with a 1:2 cement mortar (one part of cement and two parts of sand).

MIXING CONCRETE BY MACHINE

A concrete mixer operated by a gas engine saves much of the hard work in mixing, and makes better concrete

The sand and gravel are placed in the drum while it revolves, and the materials are thoroughly mixed

Add the cement. A box to hold the cement supply is advisable, as only a small amount is needed for each batch

Use water sparingly. With a bucket, measure out the same quantity of water for each batch. Never use a hose

Allow the mixing to continue for at least a minute. Longer mixing will give stronger concrete

Turn the drum to the other side of the mixer and dump the thoroughly mixed concrete into a wheelbarrow

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